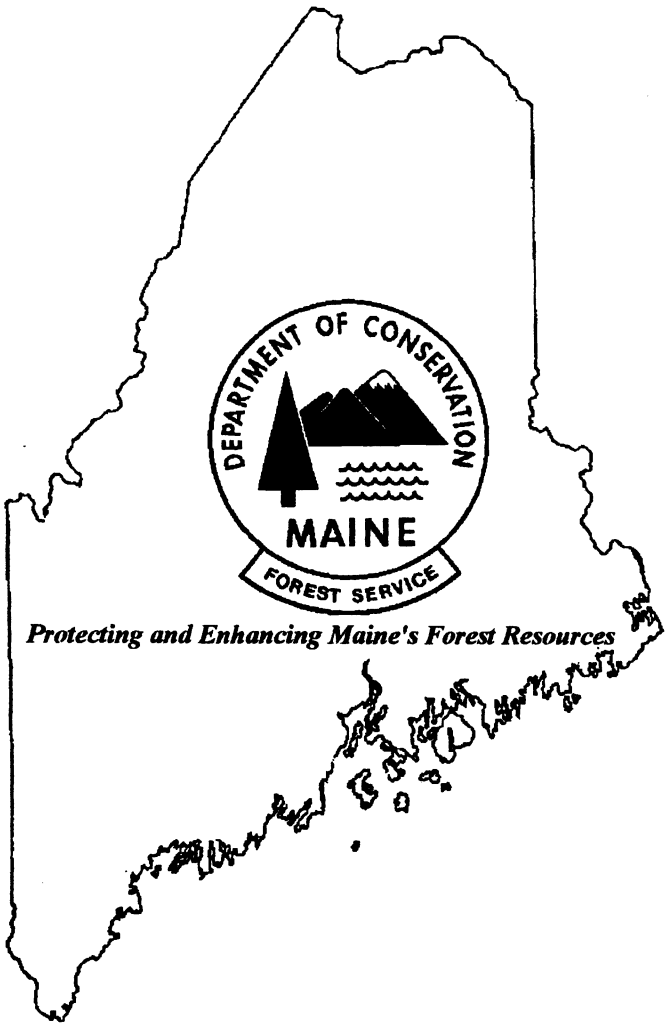
Forest & Shade Tree Insect & Disease Conditions

for Maine

A Summary of the 1993 Situation



Insect & Disease Management Division
Summary Report No. 8
March 1994

Maine Forest Service
MAINE DEPARTMENT OF CONSERVATION
Augusta, Maine

MAINE

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Acknowledgments

This summary has been compiled and edited by **Richard Dearborn** and **Clark Granger** from input received from the Insect and Disease Management staff and many cooperators. State Entomologist, **Dave Struble**, contributed entries and proofread the final draft. **Dick Bradbury**, **Henry Trial, Jr.**, **Don Ouellette** and **Dan Pratt** of our staff either wrote or contributed items. Retired pathologist **Doug Stark** was still with us this past year on special contract and was able to help us with a number of forest pathology issues. Our regular field staff, **Mike Devine, Jody Connor**, **Skip Cram**, **Mike Skinner**, **Grayln Smith** and **Dave Stewart** again scoured the state to provide us with information and records on various insects and diseases and assisted on many state and federal projects. Thanks go to the federally funded seasonal staff: **Jason Aziz**, **Joy Leavitt**, **Greg Lord**, **Kathy Murray**, **Dave Pierce**, **Dick Pierce**, **Wayne Searles** and **Caroline Skinner** who worked on the Forest Health Monitoring Program while **Rex Waite** while **Jeff Wilder** worked on the White Pine Blister Rust Program.

With this issue we have fully entered the computer era and the presence of an index as well as the changed format of many of our tables and maps reflect this changover. This could not have been done without the expertise of our federally funded biology aide, **Charlene Donahue** who, along with **Tom Driscoll**, managed to steer us along the course. We are also very grateful to our secretary **Betty Barry** whose infinite patience and ability to accurately decipher some very rough drafts again made proofreading much easier and the resulting product reach completion much more rapidly. **Dot Arbour** again assisted in bringing together our mailing list and in preparing copies of this report for mailing.

Thanks too go to many other administrative and field staff in the Maine Department of Conservation who facilitate much of our work. And last but certainly not least we thank other department personnel and cooperators in the USDA-Forest Health Protection, USDA-APHIS, Maine Department of Agriculture, University of Maine at Orono, University of Vermont and cooperators in other New England States and Maritime Provinces of Canada. Without their generous help our efforts would have fallen far short of our goals. This is our team.

FOREST & SHADE TREE INSECT & DISEASE CONDITIONS FOR MAINE

A SUMMARY OF THE 1993 SITUATION

This past season was a busy but profitable one as many of our older programs gained new significance for national forest health issues. We believe that the key to Maine's past, present, and future quality of life and economic prosperity for its citizens is permanently linked to the condition of the State's forest resources. We in the Maine Forest Service are working to ensure that the trees and forest lands of Maine will continue to provide these benefits for present and future generations of Maine people. This report provides an overview of our 1993 effort. We hope that you find it both informative and enlightening.

Comments from the State Entomologist

In retrospect, 1993 was a successful year for Insect & Disease Management (I&DM) operations. The good news internally for the I&DM Division was that budgetary support remained stable. Although preparation and defense of the biennial budget required considerable effort on the part of Bureau staff, threatened cuts were averted. This stability appears to have extended into 1994, without the need for midcycle budget adjustments. The importance of many of our activities and products is becoming increasingly realized as policy makers and the affected public attempt to grapple with new and evolving issues. Biodiversity, Sustainability, Ecosystem Management, and Global Markets are national issues that have local significance. We need to be able to respond appropriately.

In the introduction to the 1992 Summary Report we noted that the Administration and Legislature were investigating various possible changes to government structure with an eye toward cost savings and improved efficiencies. This process is still ongoing. The Maine Forest Service (MFS) remains committed to the concept of a structure that is able to address the needs of Maine's forest and shade tree resources and their owners and managers. Internally in I&DM, we continue to evaluate and modify our surveys and projects to meet increased demands on labor and products without sacrificing quality or scope of our output.

There are similar efforts underway by the Federal government to "reinvent government." Within the USDA, the U.S. Forest Service (USFS) has been identified as a "laboratory for change." At this time there is no indication that these efforts will in any way negatively impact the manner in which we address cooperative efforts.

We continue to deal with the cumulative effects of the past state budgetary woes. Reduced availability of staff time and support funding have constrained our ability to rapidly respond to identified problems. However, by maximizing cooperative approaches we have been able to address most issues and problems despite overlapping and competing requirements on staff time and efforts.

The I&DM Division continues to depend heavily on cooperative federal projects to support our legislative mandates. We have been actively developing project proposals and aggressively pursuing USFS cooperative grants to address the most pressing needs of Maine's forest resources. The specific cooperative MFS/USFS projects underway and their status are discussed later in this report.

We have continued to strengthen our partnership with USDA-APHIS to address the threats associated with exotic pests. Some of the most devestating impacts to our forests have been caused by pests that were inadvertently brought here and allowed to become established. With the increased movement of people and goods associated with the breakup of the eastern bloc, military downsizing, and development of global markets, we have increased our commitment to monitoring for exotic pests and preventing their introduction.

The other cooperative aspect supporting our efforts relates to you, our clients, coworkers and associates. The observations, reports, and samples which you send us provide a very valuable initial detection phase which we would not otherwise have. Your input gives us a network of eyes and ears on the ground throughout the state, in all types of settings. We also appreciate the strong support that you, our clientele, have shown for the Forest & Shade Tree Insect & Disease Conditions Reports. These reports are the primary vehicle for relaying general

information from us to you; it is critical that they be useful. We sincerely hope that you will read them, use them, and keep in touch with us regarding information or suggested improvements so that they will continue to meet your needs. We look forward to a close association with you again in 1994.

Personnel Notes

A former colleague, **Louis J. Lipovsky**, 76, of Brunswick, passed away March 4, 1993. Louis joined the Entomology Division of the Maine Forest Service in January of 1962 to assist with the Dutch elm disease control program. Later he worked extensively with communities on the shade tree planting program and in northern Maine with the spruce budworm suppression effort. His expertise with mites and medical entomology greatly extended our range of capabilities during his tenure here. He worked extensively with oak insects and was a frequent contributor to this newsletter.

Louis was born and grew up in Ohio. He attended the University of Kansas and received his master's degree in entomology from Washington State University. Louis served in the Army at Guadalcanal during World War II, worked briefly as a scientific consultant in Korea, and subsequently joined the staff of Walter Reed Army Medical Center where he did research for four years. He moved to Maine in 1958 and worked for several years in the Brunswick area before coming to work for the MFS in 1962. Following his retirement in 1977 Louis continued his work as tree warden for the Town of Brunswick. He was a founder of the Brunswick Farmers' Market where he sold farm produce and nursery stock he had grown on his farm, Lipovsky Gardens. He is survived by his wife and two daughters.

Louis's professional ability, community involvement, charm, and personal wit are sorely missed by his many colleagues and friends here and around the state.

Dan Pratt who was our "quarantine specialist" for many years, retired on June 30, 1993 after 29+ years of service. Dan grew up, went to school, married and settled in Clinton but his duties took him from one end of the state to the other. Dan started work in the MFS as a watchman on Dacey (Deasey) Mountain in 1964. After two seasons on Dacey he transferred to a patrolman position at Telos Lake in 1966 and then from 1967 through the 1969 season was a forest ranger on Umsaskis Lake. Dan worked winters with the USDA inspecting Christmas trees (1966-68) and at the golden nematode lab (1968-69) on Long Island, NY. In 1969 Dan came on with I&DM as a forest insect ranger in what was then District 6 (Down East). Upon the retirement of Harold Bullock in 1975 Dan took over as state quarantine inspector with federal district responsibilities. Dan's experience with quarantine work provided a good basis for this often frustrating job which he held until 1982. In 1982 the cooperative quarantine program was redefined and Dan transferred to I&DM as a regular entomologist with quarantine responsibilities. Over the years Dan held a number of responsibilities from airport supervisor down east on the spruce budworm program to light trap program supervisor. He was not afraid to take on new responsibilities and always gave his assignments his best effort. Dan will be missed although we are sure that the Masonic lodge and various town activities will benefit from his increase in available time.

Cooperative MFS/USFS Projects

North American Maple Project

The North American Maple Project was initiated in 1988 as a joint project between various states and provinces, as well as the United States and Canadian federal governments, to monitor and evaluate the condition of sugar maple stands in eastern North America. The United States Forest Service provided funding to the I&DM Division which established, and annually monitors nine pairs of sugarbush and wild stand plots in western Maine.

Although NAMP was designed to assess broad regional trends, the results have the following implications for Maine's local situation:

- The vast majority of Maine's (and the region's) sugar maples, in both wild stands and sugarbushes, appear healthy.
- Standard tapping practices show no significant adverse effect on the health of the trees.
- Reports of a general sugar maple decline driven by airborne pollution are unsubstantiated.

In 1993, in addition to monitoring tree condition, plots were remeasured to assess tree and stand growth patterns. These data have not yet been analyzed. However, analyses are underway to assess the relationships of growth and vigor to known stress events (e.g. drouth, defoliation). Preliminary results have shown no unexpected patterns.

National Forest Health Monitoring Program (NFHM)

The prototype New England Forest Health Monitoring System was initiated in 1990 in response to concerns voiced by individual states. It is expanding into a national cooperative monitoring program. Fourteen states monitored the health of their forests in 1993 using standardized methods developed under the NFHM program. While most of the states involved were in the Northeast, some southern and western states also participated. More states are expected to participate beginning in 1994, especially in the upper midwest.

The NFHM program, which is subsidized and coordinated by the USFS provides a mechanism for aggregating, analyzing, and reporting comparable regional data. The NFHM program has allowed MFS to access regional geobased information taken from 250 plots throughout New England. There are 137 of these plots in Maine. In these tight budgetary times, the ability to share data to augment locally collected information is crucial to analyzing resource needs.

The MFS has been very involved with developing the NFHM program from its inception. We continue to support the concept of an integrated, cooperative, monitoring program which provides longterm baseline information and a seamless communications network. I&DM staff are working to improve NFHM capabilities and to insure that products meet local needs. Our staff began to develop a format for accumulating additional insect and disease data from the 137 Maine plots in 1992. We are generating and are improving field guides and annual training sessions which have allowed us to acquire more specific information which is now used in our various report processes.

Competitive Focus Funding Grants

Although the hemlock looper outbreak now appears to be declining overall throughout New England and Atlantic Canada there are still some areas of concentrated defoliation. The hemlock looper problem raised a number of serious questions. Through the financial support of the USFS, a number of studies were begun by the I&DM Division and other cooperating states. While the results of some of the studies in which we have been involved have been completed and published (see publications-including Summary Report No. 7), the following two projects are still underway:

Hemlock Looper Impact Study (joint project with NH, MA, VT)
Hemlock Looper Impact in Severely Damaged Stands in Maine

Brown (= Black) Ash Health Evaluation

This cooperative project was initiated in response to increasing reports of crown dieback and mortality of brown ash in locations scattered across Maine. The initial surveys of brown ash decline conducted by I&DM staff during 1992 showed all examined plots to exhibit at least some dieback of brown ash. Overall, 60% of the brown ash examined exhibited greater than 90% dieback. Damage ranged from 15-100% of the trees in any individual plot. No cause was identified.

Based on this initial survey, the MFS received support from the USFS for an in-depth cooperative assessment of the situation in Maine. Currently, the Maine Forest Service, the U.S. Forest Service and the University of Maine are engaged in a collaborative effort to further evaluate the extent and likely causes of brown ash decline in Maine.

Specific project objectives include:

- Evaluating the health of brown ash in Maine and determining the extent and severity of the current health problems;
- Investigating correlations of various site factors with these events;
- Investigating the contribution of specific stressors as predisposing, exacerbating, or causal factors;
- Providing the owners and users of Maine's brown ash resource, and the interested public, with the findings of these investigations.

Staffing and financial support has been committed through FY95.

Management of Root Sprouting in American Beech to Enhance Numbers of Clones Resistant to Beech Bark Disease (From a progress report submitted by Dr. David R. Houston, Principal Plant Pathologist with the USFS).

This cooperative study between the USFS, the Maine Bureau of Public Lands (MBPL) and the Maine Forest Service, was established to assess the potential of two harvesting systems (clearcutting vs. partial cutting) conducted during two seasons (winter vs. summer) to manage the subsequent initiation and survival of root sprouts from root systems of cut or standing trees resistant or susceptible to beech bark disease. Accomplishments as of January 1, 1994 are summarized as follows:

- **Prior to harvests**: Trees resistant to beech bark disease were located and mapped in each of 15, 10-acre blocks of forest. Eight resistant trees and eight susceptible trees were selected in each of the 12 blocks slated for harvest; four such pairs were selected in the three control (no-cut) blocks. Complete overstory and beech bark disease data were taken on surrounding trees. In addition, regeneration data were acquired from subplots systematically placed in each block.
- **Harvests** were conducted in the winter-late spring and summer of 1991.
- **Following Harvests**: Overstory data were taken in all usable plots in partial cut blocks to record the physical changes in stand structure created by the harvest. In 1992 and again in 1993, the total number of beech sprouts and seedlings in 15 foot-radius plots centered on plot trees or stumps were counted. In each plot, up to 20 sprouts (or seedlings if 20 sprouts were not found) were tagged, numbered, and mapped, and their ages, diameters and heights determined. Data were taken on the size of the parent roots and where sprouts originated. In the second year (1993) new seedlings or sprouts were added, when available, to bring the totals to 20, and the causes of mortality of seedlings or sprouts were noted. In 1993, 3153 sprouts or seedlings were measured.
- **Results to date**: Results are very preliminary. Marked differences occurred in the number of seedlings or sprouts present in the study plots and these differences were block-related. However, whether differences were due to treatment, to inherent block differences, or both is not yet clear. Mortality of sprouts was high in some summer clear-cut areas due to extreme exposure to drying winds and sun. Less sprouting occurred in winter-cut blocks than in summer-cut blocks (as expected), while seedlings were much more abundant in some winter-cut blocks (unexpected) than in summer-cut blocks. Moose browsing was significant in some plots; and in others, high seedling mortality was caused by oyster shell scale.

The initial study plan called for the third and final measurements on individual sprouts and seedlings to be made in summer 1994. We plan to remeasure the set of regeneration plots established prior to harvest and to assess the general effects of different harvest treatments. If possible, we will establish additional randomly placed plots to assess regeneration patterns in the study blocks and also in a series of stands nearby where MBPL personnel have supervised harvest operations and have knowledge of harvest times and methods used.

However, it is quite apparent that measuring the fate of sprouts and seedlings for only three years after harvesting is not adequate to predict survivorship at some point in the future. The sprouts now being measured are slated for destruction in 1994 to determine their parental affiliation (i.e., do they belong to the central plot stump or

tree). We are discussing with cooperators the desirability of postponing or cancelling destructive sampling to allow additional remeasurement(s) at some future date.

Publications

The I&DM Division continues to maintain a file of publications on programs and pests of importance to Maine's tree resources, both forest and urban. This file includes such publications as: Field Book of Destructive Forest Insects (Bull. 25, 1980 - limited copies still available) and The Planting and Care of Shade Trees (Bull. 10, 1985). Readers are apprised of current pest developments through seasonal condition reports, and the summary issues provide useful planning information. A number of internal reports on various projects and division accomplishments are also on file. We also maintain an up-to-date supply of USDA-Forest Service Pest Alerts (Northeastern area). Two new alerts, one each on the **Browntail Moth** and the **European Spruce Bark Beetle,** were added in 1993.

The I&DM staff also worked with personnel from the USFS and other northestern states in a number of joint studies and accomplishment reports. Our staff continues to contribute items of interest to the news media and various association newsletters as well.

The following new items were published, contributed to, or completed over the past year by I&DM staff:

Dearborn, R.G. and C.P. Donahue. 1993 (December). The forest insect survey of Maine - An annotated list of insects collected and recorded by the Maine Forest Service: Order Coleoptera (Beetles). MFS, I&DM Division Technical Report No. 32. 118 pp.

Grehan, J.R., B.L. Parker and R.G. Dearborn. In Press. Description of the first and final instar of the hemlock loopers *Lambdina athasaria* (Walker) and *Lambdina fiscellaria* (Guenee) (Lepidoptera: Geometridae).

Insect & Disease Management Division. 1993 (February). Forest & Shade Tree-Insect & Disease Conditions for Maine - A Summary of the 1992 Situation. MFS, I&DM Division. Summary Report No. 7. 73 pp. Compiled and edited by R.G. Dearborn and C.A. Granger.

------ 1993. Forest & Shade Tree-Insect & Disease Conditions for Maine. 8 issues from April 21 through October 6. MFS, I&DM Div. Compiled and edited by R.G. Dearborn and C.A. Granger.

M.F.S. 1994 (January). Assessment of Maine's wood supply. Miscellaneous MFS document. Third Printing. 38 pp.

Murdoch, C.W., F. Caruso, M.R. Mollicone, D. Stone and W. Wright. 1993 (August). Index of plant diseases in Maine. Me. Agr. & For. Expt. Sta. Misc. Publ. 720. 117 pp.

University of Massachusetts Cooperative Extension Service. In Press. 1994 New England Management Recommendations for Insects, Diseases and Weeds of Shade Trees and Woody Ornamentals. Compiled and edited by R.D. Childs and M. Castonguay, with assistance from the Maine Forest Service and other New England state agencies. 252 pp.

There are other regional publications which were completed during the past year which includes Maine data which may be of interest to our readers:

Gillespie, A.J.R., M. Miller-Weeks, C. Barnett and W. Burkman. 1993 (November). Summary Report-Forest Health Monitoring, New England/Mid-Atlantic 1992. USDA-FS-NEFES. NE/NA-INF-115-R93. 15 pp.

Millers, I., D.C. Allen, D. Lachance and R. Cymbala. 1993 (September). Sugar Maple Crown Conditions Improve Between 1988 and 1992. USDA-FS-NA-TP-03-93. A foldout brochure.

U.S.F.S. 1993 (April). Healthy Forests for America's Future. A strategic Plan. USDA-FS Report MP-1513 58 pp.

------ 1994. Northeastern area forest health report. 1992. USDA-FS Report NA-TP-01-94. 61 pp.

Forest Insect and Disease Conditions for Maine

Highlights of the 1993 Season

While a number of major pest problems declined in the extent and intensity of damage in 1993, the diversity of problems encountered remained similar to previous seasons and a number of "new" ones were recorded. Monitoring efforts during the past year included specific project or pest surveys, ongoing routine surveys such as those involving use of light traps, and forest health monitoring plot surveys. Requests for advice and assistance provided additional information on a number of pest problems to round out a balanced surveillance program. Table 1 highlights many of the problems encountered in 1993. Each of those listed had significance locally, and some had a broader impact.

We are frequently asked about the Maine status of a number of pests recently introduced into this country which have received national attention. Four of the more commonly mentioned are: the **Asian gypsy moth**, **common pine shoot beetle** (***Tomicus***), **European spruce bark beetle** and the **hemlock woolly adelgid**. These species have **NOT YET** been found in Maine although surveillance efforts are underway.

Quarantines changed little in 1993. Quarantines are discussed in more detail later in this report.

Each year division personnel acquire a certain amount of unusual or anecdotal information which could be of interest to our readers but which would not normally be available to them. As we try to consolidate more of our reporting formats for the Division we may be including more of this anecdotal information in these summary reports. One such set of observations included in this summary involves a discussion of possible **spider predators** associated with the **large aspen tortrix**. Another involves comments on a **bark beetle survey** conducted at Maine foreign ports of entry by USDA-APHIS personnel. We have also enclosed information provided by personnel of the Me. Dept. of Agr., which may also be of interest to you on pests such as the **bagworm, hydrangea leaf tier** and **oriental beetle**.

Table 1. Pest problems status for 1993 and damage level trends from 1992 -1993.

New in 1993

Black Army Cutworm.....	50 A. New as a forestry problem, NOT new to Me.
Butternut Canker.....	Newly discovered in Maine.
Dogwood Anthracnose....	Newly discovered in Maine.

Those of special significance

Aspen Leafroller/tiers.....	↗*	70,000 A.	Gypsy Moth.....	↓	50,694 A.
Balsam Fir Sawfly.....	↓	2,500 A.	Heat injury.....	↑	moderate
Balsam Twig Aphid.....	↓	moderate	Hemlock Looper.....	↓	42,100 A.
Birch Skeletonizer.....	↑	very high	Late Spring Frost.....	↘	low
Brown Ash Decline.....	→	high	Meadow Vole Damage.....	→	42 A.
Bud Abortion (balsam fir).	→	low	Pinewood Nematode.....	↗	local
Browntail Moth.....	↗	local	Salt Spray Damage.....	↑	high
Bruce Spanworm.....	↑	7,500 A.	Satin Moth.....	↘	1,430 A
Cone Buds (balsam fir).....	↗	high	White Ash Dieback.....	↑	moderate
Drought.....	↗	moderate	Winter Browning.....	↑	>300,000 A.
European Larch Canker....	→	static	Yellowheaded Spruce Sawfly.	→	high
Fall Cankerworm.....	↗	box elder only			

Perennial Problems

Air Pollution.....	↗	moderate	Larch Casebearer.....	→	high, local
Annosus Root Rot.....	→	low	Larch Sawfly.....	→	100 A.
Ash Anthracnose.....	→	low	Large Aspen Tortrix.....	↓	900 A.
Ash Leaf and Twig Rust....	→	low	Oak Leaftier/Skeletonizer.....	→	low
Arborvitae Leafminer.....	↓	low	Pear Thrips.....	→	low
Balsam Gall Midge.....	→	low	Pine Needle Rust.....	→	low
Beech Bark Disease.....	→	high	Porcupine Damage.....	→	locally high
Birch Casebearer.....	↓	low	Rhabdocline Needle Cast.....	↗	high
Birch Leafminer (*Messa*)..	→	moderate	Saddled Prominent.....	→	low
Boxelder Canker.....	↑	moderate	Saratoga Spittlebug.....	→	low
Coral Spot Nectria Canker.	↗	moderate	Scleroderris Canker.....	→	low
Cristulariella Leaf Spot.....	→	very low	Sirococcus Shoot Blight.....	↗	moderate
Dutch Elm Disease.....	→	high	Spruce Budmoth.....	→	moderate
Eastern Larch Beetle.....	↘	moderate	Spruce Budworm.....	→	low
Fall Webworm.....	↓	except high SW Me.	Stillwell's Syndrome.....	→	low
Fir-fern Rust.....	→	low	White Pine Blister Rust.....	→	low
Forest Tent Caterpillar.....	→	very low	White Pine Weevil.....	→	high
Horse Chestnut Leaf Blot...	→	moderate			

* damage levels: ↗- up slightly; ↘- down slightly; ↑- up; ↓- down; →- stable at level indicated.

Light Trap Survey

The fifty first annual insect light trap survey was conducted during 1993 at twenty three locations (Figure 1). Traps were situated throughout the State in stands representing both hardwood and softwood types. These were operated during the peak period of activity for adults of the various pests of the primary tree species in their respective areas. Only lepidopterous pests have been monitored regularly by this system so far. Roughly twenty pests are monitored on a fairly consistent basis and of these, eleven are compared annually. The results of seasonal catches are used to supplement data from other surveys such as those for larvae, damage or to compare to pheromone catches. These trap catches are also monitored for new and unusual species, especially in southwestern Maine at South Berwick where an oak-hickory forest type is present (one of the few such areas in Maine). A summary of the results of this survey for 1993 has been interwoven into the regular report under the specific pests involved.

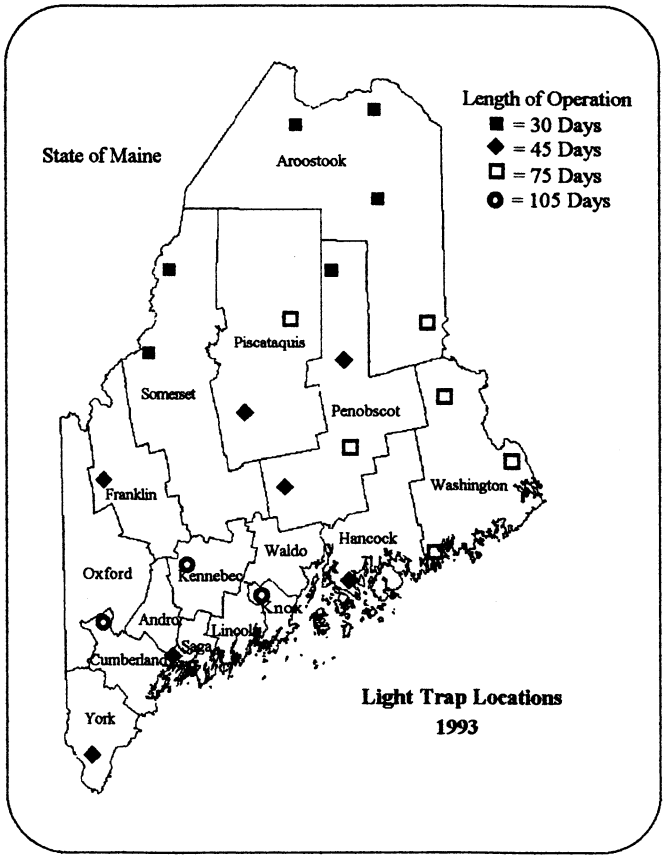

Figure 1

Biophysical Regions

A series of 15 **Biophysical Regions** (Figure 2) was developed for Maine in 1990 by Janet S. McMahon under a grant with the Maine State Planning Office. These regions were developed using computer overlays of four sets of criteria: physiography, climate, surficial geology and soils, and vegetation and flora. We again endeavored to implement this system in 1993 but it has not yet been fully integrated with our regular surveys. As more emphasis is placed on defining forest type zones or ecozones this system will become more practical. More information on the use of this type of system is included in the 1993 report by Janet McMahon:

McMahon, J. and J. Bernard. 1993 (May) An ecological reserves system for Maine: Benchmarks in a changing Landscape. A report to the 116th Maine Legislature. Natr. Res. Policy Div. Maine State Planning Office 94 pp. & foldout map of Biophysical Regions of Maine.

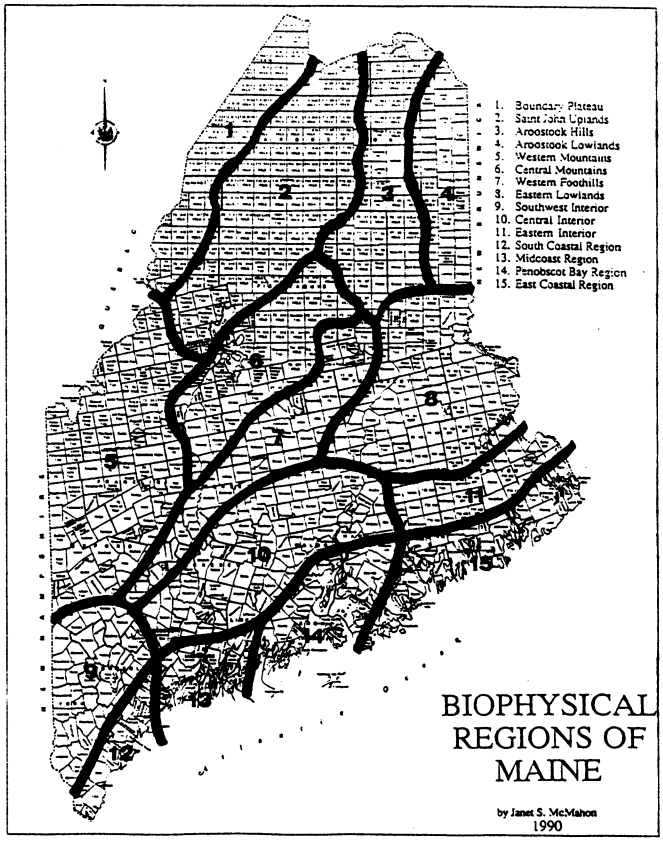

Figure 2

Useful Suggestions

This report is again rather lengthy and many readers may only want to read selected sections or about items of particular interest to them. We have tried to improve the format this year to make it easier to target particular items. In addition to Table 1 and the "Highlights" section, we have added an index this year but you may still wish to scan the entire report first to pick up new items of interest as well as to save time. Keep in mind the following when scanning for particular problems:

- **Insect problems** are broken down into three categories. All **softwood insect pests** including those in plantation and ornamental situations, are grouped in Section A. Most **hardwood insect pests** are discussed in Section B. **Insect pests of shade trees, ornamentals and shrubs** can be found in Section C along with **insects and other arthropods of medical or nuisance significance.**
- **Tree diseases** are listed alphabetically in a separate section beginning on page 37.

We hope that you will find these suggestions helpful. Any comments or suggestions for further improvement are welcome.

INSECT Problems Associated With Trees in 1993

(A) Insect Pests of Softwoods
(including plantations, nurseries and Christmas trees)

Aphids - Aphids were again present on many conifers but damage was generally light. The balsam twig aphid was one exception. Adelgids are often confused with aphids. Some such as the **balsam woolly adelgid**, **pine leaf adelgid** and **red spruce adelgid** are discussed elsewhere in this section. The more visible, typical, black ***Cinara* aphids** were again common but appeared to be much more local than in 1992. Breakage of white pine leaders above weakened, previous years concentrated feeding sites was a noticeable problem in plantations and on ornamentals.

Arborvitae leafminer (a complex of 4 species) - Populations declined in most areas in 1993 and where increases were observed they were extremely light. In spite of this trend, mortality continues to increase in some stands.

The impact of this complex on the health of arborvitae is not fully understood especially in light of other problems currently influencing the same stands. An effort to define this problem is in the planning stage.Twenty sites scattered throughout the resource (Figure 3) are surveyed for this pest each winter. The results are annually compared with the previous season to determine trends (Table 2).

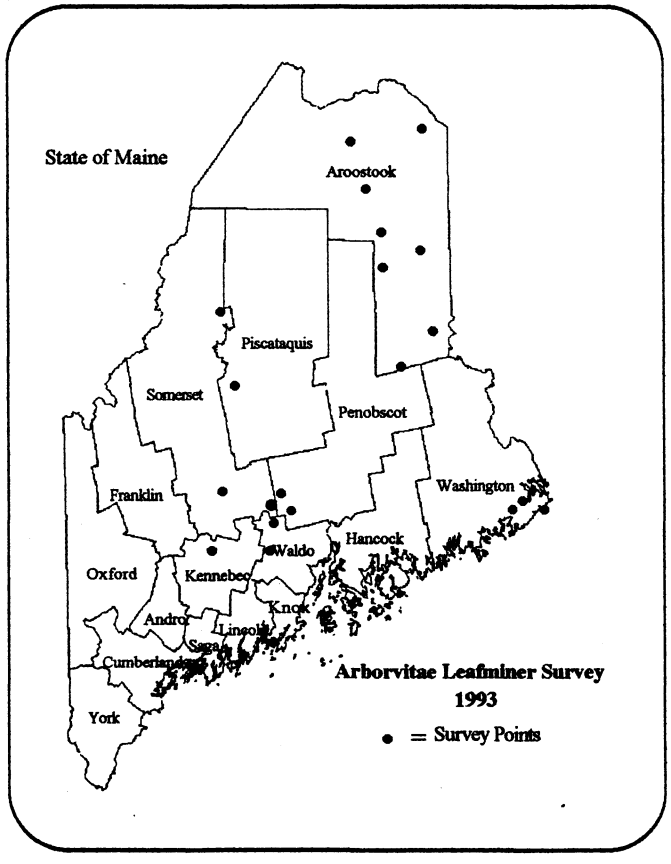

Figure 3

Table 2. Arborvitae leaf miner winter population survey

Location	# Live Larvae /3" Twig 1992	# Live Larvae /3" Twig 1993	Change
Palmyra	1.03	0.62	-0.41
Belgrade	0.30	1.16	+0.86
Plymouth/Dixmont	1.03	1.40	+0.37
Cornville	0.66	0.99	+0.33
Newport	0.30	0.29	-0.01
Freedom	0.39	0.79	+0.40
Detroit	3.83	1.38	-2.45
Whiting	0.36	0.49	+0.13
Trescott	1.08	1.04	-0.04
Edmunds	0.41	0.38	-0.03
Ludlow	0.13	0.07	-0.06
Moro	0.75	0.02	-0.73
Nashville	0.27	0.29	+0.02
T9-R5	0.06	0.22	+0.16
Winterville	0.40	0.17	-0.23
Orient	0.42	0.04	-0.38
Macwahoc	0.11	0.01	-0.10
Little Squaw	0.12	0.11	-0.01
Seboomook	0.17	0.10	-0.07

Balsam Fir Sawfly (***Neodiprion abietis***) - Populations of this species appeared to decline in 1993 from 1992 levels although there was some evidence of defoliation throughout the area defoliated in 1992. Defoliation was most visible in 1993 in pockets covering roughly 2,500 acres in the town of Addison (Washington County).

Balsam Gall Midge (***Paradiplosis tumifex***) - Populations of this species were spotty and generally low again in 1993 as they appeared to continue to decline for the third year.

Balsam Shootboring Sawfly (***Pleroneura brunneicornis***) - Although damage by this species was again evident on balsam fir Christmas trees in some coastal areas, it did not seem to be as severe overall. This perplexing problem seems to plague some growers and not others and control success is variable. The best control would still appear to be not to grow balsam fir Christmas trees adjacent to wild stock in areas where the problem persists.

Balsam Twig Aphid (***Mindarus abietinus***) - Populations of this species and resultant damage dropped dramatically overall in 1993 from the epidemic levels of 1992. Locally heavy damage was reported however and many Christmas tree growers treated to protect tree quality. A survey of fir tips for levels of damage was conducted prior to the 1993 wreath brush "tipping" season. As expected the results were extremely variable and some differences were very localized even within the same plantation or stand. Figure 4 reflects the general conditions found. The most noticeable difference was the greatly reduced twig aphid populations and damage in eastern and northern Maine in 1993. Two exceptions to this general trend in the east were identified, one in south central Hancock County and another in southeastern Piscataquis County. These two areas had sustained moderate to heavy damage this year and were generally more heavily damaged than in 1992. In western Maine, the majority of areas evaluated were also found to have sustained moderate to heavy damage this year compared to lower levels seen in 1992. Generally the areas that received the most severe damage in 1992, mostly in the east and north, saw a significant twig aphid collapse in 1993. Areas in the west that had relatively low 1992 populations

experienced generally increased damage in 1993.

This problem seems to be fairly chronic in most areas with some seasonal fluctuation. Populations have been relatively high and damage noticeable somewhere within the state since at least 1985. No estimate of 1994 populations is available at this point although they are expected to remain variable with declines overall more common. Christmas tree growers should be very watchful of this pest especially as trees near the harvest year.

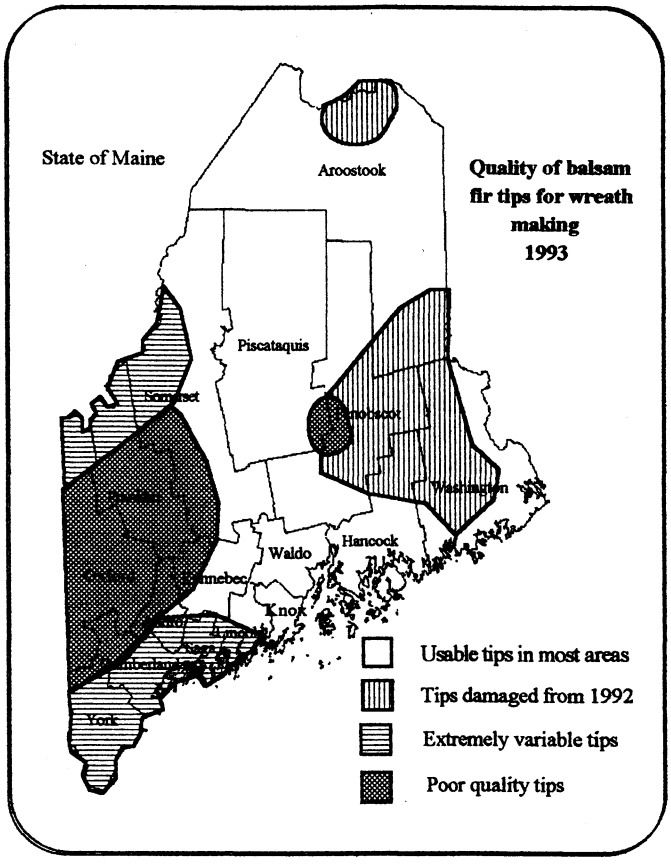

Figure 4

Balsam Woolly Adelgid (*Adelges piceae*) - The gout phase of this pest continues to predominate in most areas, especially coastal eastern Maine although the incidence of new areas of the woolly trunk phase rose slightly in 1993. Most reports of trunk phase were light and/or spotty and were from central Maine and inland areas of eastern Maine. The importance of this pest may increase within the younger forest stands of balsam fir which are now becoming more evident across much of Maine.

Bark Beetles (various) - Bark beetles have played an important role in accelerating the decline of stressed softwoods in Maine but have seldom been the primary pests that western species have. Two of the more notably destructive species in Maine over the years have been the **eastern larch (bark) beetle** and the **spruce beetle**. These are discussed separately.

Recently concern has risen over the potential for damage from introduced species. This is especially important as more and more movement of wood, wood products, Christmas trees and nursery stock occurs. Introduction of serious pests with these commodities could jeopardize the industry as well. Emphasis on trapping using pheromones and simple sticky traps, especially at ports of entry, by Me. Coop. Ext. Serv. personnel in cooperation with the USDA-APHIS-PPQ produced some interesting results in 1993. One such survey conducted in 1993 focused around the Portland and Searsport area and at least one new species (for Maine), *Hylastes opacus*, was found in Lincolnville. Two other imports of recent concern in the United States but which have not been found in Maine; the **common pine shoot beetle** and the **European spruce bark beetle** (*Ips typographus*), are a good example of the potential and others are beginning to show up. To prevent introductions such as these, stock entering Maine should be checked and refused if found infested. Reciprocally, we should not be exporting infested stock.

Black Army Cutworm (*Actebia fennica*) - Although this species has been known from Maine for years and has been a problem in blueberry production areas in the past, we have not considered it a forestry problem - until now. Heavy larval feeding was reported in June on a 50 acre new plantation of young black spruce in north central Maine. Similar situations have been reported from Canada. All larvae had pupated in the area when field checks were made in mid to late June. The moths emerged in early July. This species overwinters as partially grown larvae. Although this cutworm seems to prefer fireweed and other low plants, it will eat anything green in its way. In large numbers larvae act like typical "army worms" and move in masses through a suitable feeding area chewing off and/or eating just about everything green.

Common Pine Shoot Beetle (*Tomicus piniperda*) - This introduced European pest of pines has not yet ben found in Maine.

Conifer Sawflies (various) - Sawfly defoliation of conifers was not as noticeable in 1993 as in 1992 except in the case of the **yellowheaded spruce sawfly** (page 19).

Conifer Swift Moth (*Korscheltellus gracilus*) - This species takes two years to mature and moths should appear in August of 1994. Larvae were fairly easy to find in the duff beneath red spruce in mid to late summer of 1993.

Cooley Spruce Gall Adelgid (*Adelges cooleyi*) - In Maine this species alternates between galls on Colorado blue spruce and a free feeding woolly form on Douglas-fir. Although ornamental blue spruce are occasionally heavily galled by this species, feeding discoloration on Douglas-fir can be so heavy as to render them aesthetically worthless for Christmas trees or ornamentals. Populations vary little from year to year in Maine and seem to be chronic in some plantations or on some ornamentals. Growers who wish to raise Douglas-fir should be aware of this problem.

Eastern Larch (Bark) Beetle (*Dendroctonus simplex*) - This problem appears to be stabilizing overall and the frequency of reports of new areas declining. Stands exhibiting mortality are often striking especially in more developed areas of southern Maine but the extent of mortality within the resource may not be as high as previously expected. Further work will be conducted in 1994 to further define the impact of the problem.

European Pine Shoot Moth (*Rhyacionia buoliana*) - This species continues to be a problem on red pine in Maine primarily in Sagadahoc and Lincoln Counties.

Fir Coneworm (*Dioryctria abietivorella*) - Tip mining activity by this species was not generally noticeable in 1993 and no reports of damage were received.

Gypsy Moth (*Lymantria dispar*) - See pp. 25, 51, 53.

Hemlock Loopers (*Lambdina athasaria* and *L. fiscellaria*) - Although both of these species occur in Maine, it is *L. fiscellaria* which causes most of our defoliation. Defoliation by *L. fiscellaria* dropped strikingly during the 1993 season. Aerial surveys detected only 42,100 acres of moderate defoliation during 1993. There were no areas of heavy or severe current defoliation as there have been in previous seasons and many areas were difficult to assess from the air. A more complete assessment of the hemlock looper situation in Maine in 1993 is included in the special reports section (page 55).

Extremely dry conditions during the summer of 1993 and cold, open conditions during much of last winter may have contributed to additional tree mortality in the hemlock and fir stands which were severely defoliated during 1991 and 1992. We are evaluating the impact of looper feeding on tree mortality in heavily damaged stands and a report will be available early in 1994.

Light traps were again used to monitor populations of both *L. athasaria* and *L. fiscellaria* in 1993. The result of catches from eleven traps used to monitor *L. fiscellaria* can be found in the special reports section (page 57). Four traps were operated from mid May to late June especially for *L. athasaria.* The numbers of moths caught in 1993 dropped noticeably from 1992 levels except for a small increase at Mt. Vernon (Table 3).

Table 3. Numbers of *Lambdina athasaria* moths collected at light

Trap Location	Number of Moths	
	1992	1993
North Bridgton	81	34
Mt. Vernon	2	7
South Berwick	1	0
Washington	0	0
Totals	**84**	**41**

Hemlock Woolly Adelgid (*Adelges tsugae*) - There is still no evidence of any infestation of this species in Maine even though the distribution of the species expanded greatly in Massachusetts in 1993. The Maine Forest Service and the Maine Department of Agriculture continue to monitor the status of this pest closely and maintain a joint quarantine regulating the importation of hemlock products from infested areas (Quarantines page 52). Forest stands in Maine were monitored for this pest during 1993 in conjunction with hemlock looper surveys. Nursery stock and ornamentals were also monitored by staff of the Maine Department of Agriculture through their regular inspection programs.

Movement of hemlock forest products from potentially infested areas is regulated and monitored by I&DM staff and their associates in adjacent states to minimize the risk of importation. Commercial shipments from nurseries in infested states are similarly regulated by the Me. Dept. of Agr. and their counterparts. Despite these efforts there is considerable risk of importing this pest by homeowners who transport seedlings and foundation stock from southern New England and the mid Atlantic area. To help in preventing the introduction of the hemlock woolly adelgid hemlock nursery stock should not be brought to Maine from infested areas. Ornamental plantings in Maine which include hemlock should be checked to see if the adelgid is present. Any woolly insects on twigs or foliage should be suspect. Suspected infestations should be reported immediately to either the State Horticulturist (Me. Dept. of Agr., State House Station #28, Phone (207) 287-3891) or MFS, I&DM (Phone (207) 287-2431). Cooperation is needed to protect our hemlock resource.

Jack Pine Sawfly (*Neodiprion pratti banksianae)* - Populations of this species in infested areas have remained chronic over the past few years. Defoliation of mature jack pine in coastal areas of Hancock and Washington Counties from Steuben to Mt. Desert remained localized in 1993 and again ranged from light to moderate. Most of the infested trees were on rocky, poor growing sites and therefore stunted (roughly 25± feet tall). These trees also frequently had other problems as well such as the **northern pitch twig moth** and one of the **gall rusts**.

Larch Casebearer (*Coleophora laricella*) - Stands of larch "scorched" by the feeding of this species were again very obvious throughout much of the southern half of Maine in late May and June of 1993. Damage remained stabilized at roughly 1991 levels. This is the sixth consecutive year in the present outbreak. Damage varied greatly often ranging from light (<25% of the needles affected) to heavy (>75%) within the same stand. This species is thought to be a serious stress causing factor on larch especially after two or more years of heavy defoliation.

Larch Sawfly (***Pristiphora erichsonii***) - This species did not appear to be as active in 1993 as expected and the number of reports of larval feeding was down. There were, however, two separate areas of defoliation totalling roughly 100 acres surveyed in southern Piscataquis County. This included a semimature plantation and a natural stand. No other defoliation was observed.

Mites - (See spruce spider mite p. 19)

Nesting (or Webspinning) Pine Sawflies (Pamphiliidae) - No infestations were found in 1993 although isolated webs on ornamentals were noted.

Northeastern (Pine) Sawyer (***Monochamus notatus***) - This species continues to be an opportunist in Maine. Much of Maine's pine is properly handled or sawn out quickly and does not become infested. However individual, large, mature white pine stressed by lightning or white pine blister rust often support high populations of the immature stage or roundheaded borers. Their feeding activity can cause top mortality and eventually kill entire trees. Infested trees exhibit dieback, pitching and/or coarse sawdust production.

Northern Pitch Twig Moth (***Petrova* = *Retinia albicapitana***) - "Gobs" of pitch containing larvae or pupae of this species are still very common and unsightly on twigs and branches of jack pine especially in Hancock and Washington Counties. Most of these pitch masses are at the base of small branches or around buds. Damage by this insect is usually limited to minor twig and branch mortality and the unsightly pitch masses. This species has a two year life cycle.

Pales Weevil (***Hylobius pales***) - No reports of damage from pales weevil were received in 1993.

Pine Fascicle Mite (***Trisetacus alborum***) - Populations of this species remained very low in 1993 and damage was barely detectable.

Pine Gall Weevil (***Podapion gallicola***) - This insect continues to show up wherever red pine is found but is seldom more than a nuisance. Occasionally, however, branches of some trees may be galled sufficiently to cause heavy flagging (dead branch tips). This damage, when light, can be confused with that of the **red pine cone beetle** (*Conophthorus resinosae*). Look for galls.

Pine Leaf Adelgid *(Pineus pinifoliae)* - Although galls were locally evident on red and black spruce across southern and central Maine in 1993, no reports of serious damage were observed and populations on white pine seem to be down. The population seemed to be lower in 1993 than during the previous cycle.

Pine Needleminer (***Exoteleia pinifoliella***) - This species appears to be primarily a pest of jack and pitch pine in Maine. Although populations appeared to drop in 1993, damage was still evident on plantation jack pine in eastern Maine in T3 R1 NBPP and on pitch pine at several locations in Cumberland County.

Pine Spittlebug (***Aphrophora parallela***) - Spittle masses containing the nymphs of this species were again locally very visible on a variety of conifers in 1993. This seems to be a perennial problem with occasional local outbreaks. Control is usually not necessary.

Pine Tip Boring Bark Beetles (*Pityophthorus* spp.) - The incidence of tip borers on pines, especially white pine, appeared to be low in 1993. As concern is developing over possible introduction of the **common pine shoot beetle**, we are interested in learning of tip boring beetle activity especially on plantation or ornamental Scotch or eastern white pines.

Red Spruce (Gall) Adelgid (*Pineus floccus*) - Terminal galls caused by this species on red and black spruce are normally present in Maine but generally very scattered and few in number. High numbers of galls were observed in 1992 especially at Phippsburg (Sagadahoc County) and Wellington (Piscataquis County) and migration to white pine seemed to be heavy. No damage was reported to pine in either area in 1993 however. Galls are expected again on red and black spruce in 1994. This species has a two year cycle and galls on red and black spruce predominate in even years which is opposite that of the pine leaf adelgid. Galls can be found on bog black spruce nearly every year in low numbers, however, as is the case with *P. pinifoliae*.

Saratoga Spittlebug (*Aphrophora saratogensis*) - This insect continues to be a chronic problem on some sites but especially in frost pockets, and varies in intensity from year to year. The Saratoga spittlebug in Maine is primarily a problem on plantation red pine in Androscoggin, Cumberland, Hancock, Sagadahoc and Washington Counties. No new areas were found in 1993. Most trees which had been heavily damaged in the past had either outgrown the problem or been destroyed.

Spruce Beetle (*Dendroctonus rufipennis*) - Aerial and ground surveys did not show any significant incidence of new spruce beetle attack in Maine except on roughly 50 acres on several coastal islands in Hancock County. These new areas were all associated with either old or stressed white spruce. On some islands, the white spruce had grown on old pasture sites and soils were very poor. On other islands, stress caused by hemlock looper defoliation contributed to beetle attack. Spruce in other portions of Maine attacked by spruce beetle in the late 80's have either been salvaged or are now in an advanced stage of decay. Many susceptible spruce in these areas were never attacked. A few trees showing evidence of new beetle attack were found in and near the old large infested areas in 1993. A total of 9,100 acres of spruce beetle mortality (>25% of spruce dead) were reported in 1992. Significant new areas of beetle attack are not expected in 1994.

Spruce Budmoth (*Zeiraphera canadensis*) - Although it was not difficult to find infested white spruce, populations did appear to be down and few reports by concerned individuals were received in 1993. Few plantations were surveyed specifically for this chronic pest in 1993.

Spruce Budworm (*Choristoneura fumiferana*) - No significant populations of spruce budworm larvae were detected in 1993. Surveys of a Christmas tree lot in mid coastal Maine where the owner had reported defoliation in 1992 showed evidence of light damage from 1992 budworm feeding. Larvae were easy to find in this stand early in the 1993 season but, larval numbers declined through the summer and no significant damage was observed. Apparently this localized population was a holdover from the recent outbreak and does not represent a resurgence of budworm in Maine. Reports of individual larvae in general survey and hemlock looper collections were down compared to 1992 observations. No defoliation by budworm was mapped either from the ground or aerially.

Light traps were again operated at 23 locations (Figure 1) throughout the budworm moth flight period. Moth catches from these light traps were very low as they have been for several years, even though actual numbers of moths caught did increase slightly at 11 of 23 locations. The total number of moths caught at all locations went from 16 in 1992 to 52 in 1993 (Table 4).

Table 4. Total number of spruce budworm *(Choristoneura fumiferana)* moths collected at light

Location	Year					
	1988	1989	1990	1991	1992	1993
Allagash	0	64	3	0	1	7
Ashland	0	0	0	0	0	0
Blue Hill	7	6	1	0	0	4
Brunswick	1	16	0	3	0	0
Calais			11	3	0	0
Chesuncook			0	1	0	1
Dennistown	0	0	0	0	0	0
Elliotsville	0	0	0	0	0	2
Exeter		9	10	4	5	21
Greenbush	19	10	0	1	0	1
Guerette	0	1	0	0	0	0
Haynesville		7	1	0	0	0
Kingfield	0	0	0	0	0	2
Matagamon	0	0	0	0	1	2
Millinocket	0	0	0	1	0	0
Mt. Vernon	0	0	1	0	0	2
North Bridgton	0	0	0	0	1	0
Rangeley		7	1	0	2	8
South Berwick	1	0	0	0	0	2
St. Aurelie	0	1	0	0	0	0
Steuben		548	73	8	0	0
Topsfield	1	15	0	0	0	0
Washington	0	26	2	0	6	0
Total # Moths	29	710	103	21	16	52
Total # Traps	17	21	23	23	23	23

In 1993 budworm moth activity was evaluated at 27 locations across the State with multipher traps baited with budworm pheromone provided by the US Forest Service. Moth catches in the pheromone traps have been generally very low since 1987 except for a slight "blip" in 1992 (Table 5). Moth catch per pheromone trap had been less than one moth per trap for several years, however, in 1992, five locations out of 16 had 10 or more moths per trap. Although catches declined in 1993, twelve of the 27 locations trapped did produce more than one moth per trap and in general catch was higher than the extremely low catches seen between 1987 and 1991.

Table 5. Spruce budworm pheromone trap catch**

Location	Year		Location	Year	
	1992	1993		1992	1993
Allagash		5	NE Carry		<1
Calais*	<1	<1	Princeton		2
Chesuncook*	6	2	Steuben*	32	4
Clayton Lake		2	St. Pamphile		7
Coburn Gore		1	Topsfield*	1	<1
Conner		<1	Waltham	25	>1
Daaquam		<1	Smith Pond*	6	3
Dennistown*	5	1	St. Frances Lake		1
Dickey Brook*	<1	3	Oxbow	10	<1
Duck Lake	<1	<1	Ragmuff		1
Garfield	6	2	Rangeley		>1
Greenbush*	3	<1	Ste. Aurelie*	2	<1
Haynesville*	4	1	Matagamon*	18	4
Jonesboro	11	1			

* Light trap location

** These figures reflect a per trap average from a cluster of three traps

Spruce Spider Mite (*Oligonychus ununguis*) - Mites are one of those perennial problems with great variability in local and seasonal populations. They do, however, appear to be more of a serious problem on ornamentals and Christmas trees. Weather conditions were very favorable for the development of spruce spider mites in many parts of Maine in 1993. Populations reached damaging levels on balsam and Fraser fir, especially in portions of central Maine and mottling of the foliage was often evident.

White Pine Weevil (*Pissodes strobi*) - The white pine weevil is one of those chronic problems in most areas of Maine and seriously limits growth of good straight white pine unless controlled. The number of requests for advice and assistance on this problem in 1993 was fairly normal and most involved only white pine or Colorado blue spruce. There were few reports of attacks on other species such as black or Norway spruce or other pines. The white pine weevil continues to cause serious stem deformity on much of the regenerating white pine within the state. Mortality of the main leader is often as high as 90% or more in plantations and other open grown trees which are four feet or more in height.

Yellowheaded Spruce Sawfly (*Pikonema alaskensis*) - Larvae of this species continued to defoliate roadside, plantation, ornamental and other open grown spruce across much of Maine in 1993. White spruce appeared to be preferred although heavy defoliation was also observed on Norway and Colorado blue spruce. Damage was most severe and widespread along roadsides in Androscoggin, Aroostook, Cumberland, Hancock, Kennebec, Knox, Lincoln, Penobscot, Sagadahoc and Waldo Counties. This was apparently the third year in the current outbreak although populations were not thoroughly surveyed. As usual, most areas checked also showed the presence of low numbers of the **greenheaded spruce sawfly** (*Pikonema dimmockii*) . These two species usually occur together but it is the yellowheaded which is a problem.

(B) Insect Pests of Hardwoods

Alder Flea Beetle - Section C page 33.

Aphids, Leafhoppers, Treehoppers and Scales (various) - These small and most often inconspicuous plant sucking insects remained inconspicuous for the most part in 1993. Aside from very local infestations generally involving individual trees, only the **woolly alder aphid** on silver maple seemed to generate wider notoriety (page 32).

Aspen Leafroller (*Pseudexentera oregonana*) - Poplar foliage was very thin due to feeding by larvae of this species in 1993 in many stands across south central Aroostook County, especially from Westfield to T11R7 and in northern Piscataquis County from Munsungan Lake to Ross Lake (Figure 5). Roughly 70,000 acres were affected within this area; 50,000 in Aroostook County and 20,000 in Piscataquis County. Defoliation was variable elsewhere in northern Maine but with only very local "hot spots." Defoliated stands seemed to be less contiguous than in 1992 but fell roughly into the same area. Aspen leafroller populations were light throughout central and eastern Maine and were not reported from other parts of the state. See also **large aspen tortrix** (p. 26) and **satin moth** (p. 30).

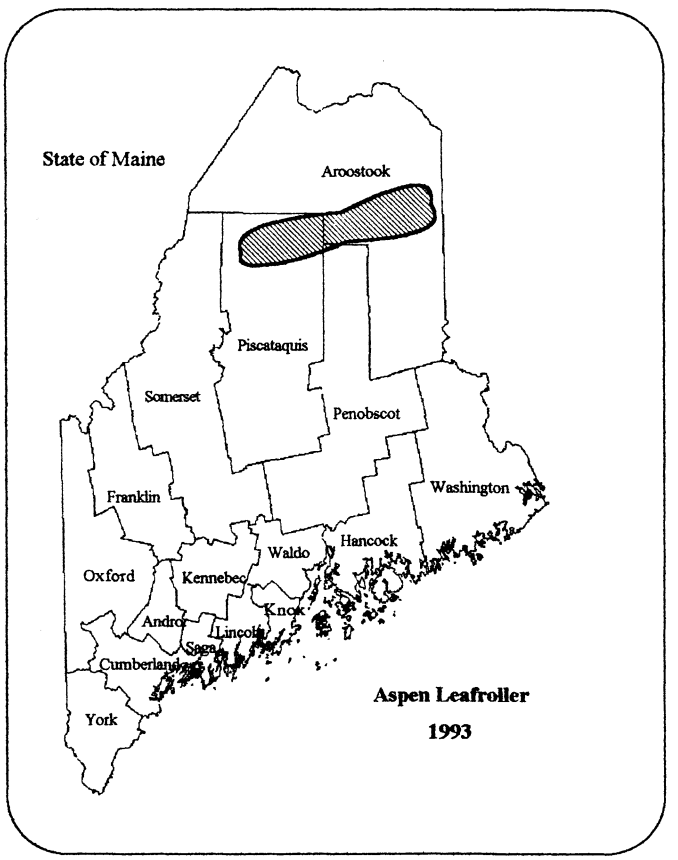

Figure 5

Balsam Poplar Leafminer (*Lyonetia* sp.) - Populations of this species remained very low in 1993 in infested areas of Aroostook County. Although damage was still visible from the ground in some stands, it was spotty, light and lacked the reddening effect of previous years. Balsam poplar in central and southern Maine were infested with larvae of the **willow flea weevil** (page 32).

Beech Scale (*Cryptococcus fagisuga*) - This scale is widespread throughout the state and is associated with the *Nectria* fungus and with other scales such as the **birch margarodid** (*Xylococculus betulae*) and the **oystershell scale** (*Lepidosaphes ulmi*). Populations of *C. fagisuga* have remained relatively low for a number of years although they will vary from place to place. It is *Nectria* which causes the more serious damage. The **twice-stabbed lady beetle** (*Chilocorus stigma*) is a very effective predator on beech scale.

Birch Casebearer (*Coleophora serratella*) - Defoliation of birch by this species in 1993 was lighter and more local than in 1992 except in northern and eastern Maine where scattered understory lakeside and roadside trees "sported" moderate to heavy populations.

Birch Catkin Bug (*Kleidocerys resedae*) - This seed feeder was unusually common in 1993 and birch catkins were often covered with nymphs in August. It also feeds on the seeds of other shrubs as well and adults often become a nuisance as they enter homes in the fall.

Birch Leafminer (primarily *Messa nana*) - The area of moderate to heavy damage from this leafminer has remained fairly stable since 1990 while low populations are still evident over a much wider area. While at least light populations could be found on all birch species throughout the state in 1993, most areas of noticeable (moderate to severe) defoliation were in southern Maine (Figure 6). Heavy to severe defoliation occurred in Waldo and extreme southern Penobscot, Lincoln and Knox Counties.

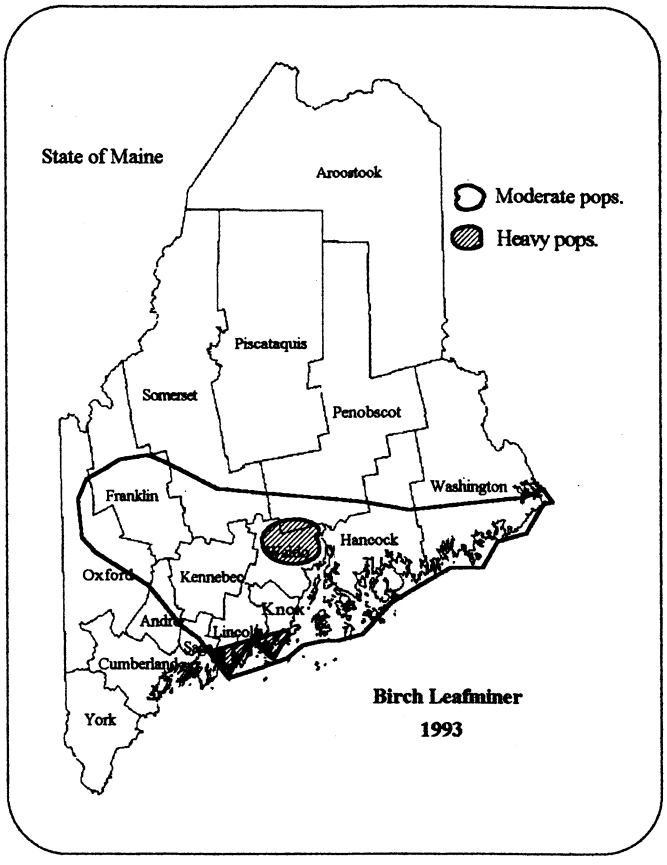

Figure 6

Birch Problems (various) - In addition to specific birch pests already mentioned, **fall webworm** (page23), and **Japanese beetle** (Section C page 34) again caused locally significant defoliation in southern Maine. **Lacebugs** (*Corythuca* spp.) again caused noticeable mottling and yellowing of some trees as well, especially ornamentals.

Birch Sawfly (*Arge pectoralis*) - Populations of this species remained very low again in 1993. No defoliation was reported.

Birch Skeletonizer (*Bucculatrix canadensisella*) - Populations of the birch skeletonizer have continued to rise since 1990 but they were higher and damage heavier in 1993 than any other year for more than 30 years. While damage to birch by this late season feeder was evident throughout most of the state it was most noticeable in Androscoggin, Aroostook, Franklin, Hancock, Kennebec, Oxford, Penobscot and Waldo Counties. No acreage figures are available. The impact of this late season defoliator is probably mainly aesthetic causing premature browning and yellowing of foliage although in some seasons it may become another stress factor.

Bronze Birch Borer - (*Agrilus anxius*) - Dead-topped birch which show characteristic results of infestations of this species continue to show up throughout the birch resource especially where stress factors have pushed birch to the "brink." This and other problems have been responsible for what has often been termed birch decline. Although dead topped birch which are the result of bronze birch borer attack are often striking, our continuing birch decline surveys do not show any distinct resurgence of the problem experienced in the 1940's.

Browntail Moth (*Euproctis chrysorrhoea*) - Browntail moth populations have intensified on infested islands within Casco Bay and have spread from these islands to scattered locations on the mainland. The results of road and foot scouting surveys conducted in April of 1993 to locate the overwintering larval webs of this species (Table 6) indicate an expansion both to the south (Cape Elizabeth) and to the north (Brunswick). A single web was found and destroyed in Phippsburg in 1992, but none were found in this area during the 1993 survey. Out of 23 light traps operated throughout the state in 1993 (page 9) only one (Brunswick) again caught a single browntail moth. Over 300 webs had been observed on several species of trees over ten to twelve acres on the Brunswick Naval Air Station in March of 1993 by USDA-APHIS-PPQ personnel. This information was relayed to station personnel but apparently no action was taken.

Table 6. Overwintering webs of the browntail moth in 1993

Location	# Webs	Location	# Webs
Harpswell	36	South Portland	2
Brunswick	118*	Portland	10
Freeport	3	Long Island	100+
Yarmouth	12	Bath	0
Cumberland	327+	Phippsburg	0
Falmouth	37	West Bath	0
Cape Elizabeth	5		
*MFS count only			

A field trial using *Bacillus thuringiensis* (Foray 48B) was conducted in the spring using two applications ten days apart at a rate of 24 BIU's each. This treatment did not kill enough larvae to reduce contact with residents and consequently the application was considered unsuccessful. The project was done on Little Diamond Island and was funded by Novo Nordisk Bioindustrials Inc. with the cooperation and assistance of the City of Portland.

Reports of dermatitis resulting from contact with urticating hairs from this insect were very common this past season particularly at the Peaks Island Health Clinic. The problem became especially acute after pupation when the cast skins and loose larval hairs were blown around by the wind and human activities such as lawn mowing. An unusually windy period in late June exacerbated the problem which extended throughout much of July.

Bruce Spanworm (*Operophtera bruceata)* - Several areas of defoliation by this species were reported in western and north central Maine this season. Defoliation appeared to be limited to sugar maple and beech and was heaviest on understory trees. Although feeding appeared to be moderate to heavy in the understory, it was generally light in the overstory making aerial surveys difficult. Defoliation was visible on approximately 7,500 acres in Oxford (scattered stands) and northern Piscataquis (primarily T8 R10 and T10 R10) Counties. Lighter defoliation was also reported in Franklin and Somerset Counties. (Figure 7).

Populations were up from previous levels and moth activity was noticeable in the fall of 1993. Moth activity was up in Aroostook County as well but with little damage evident. This is one to watch for early in 1994.

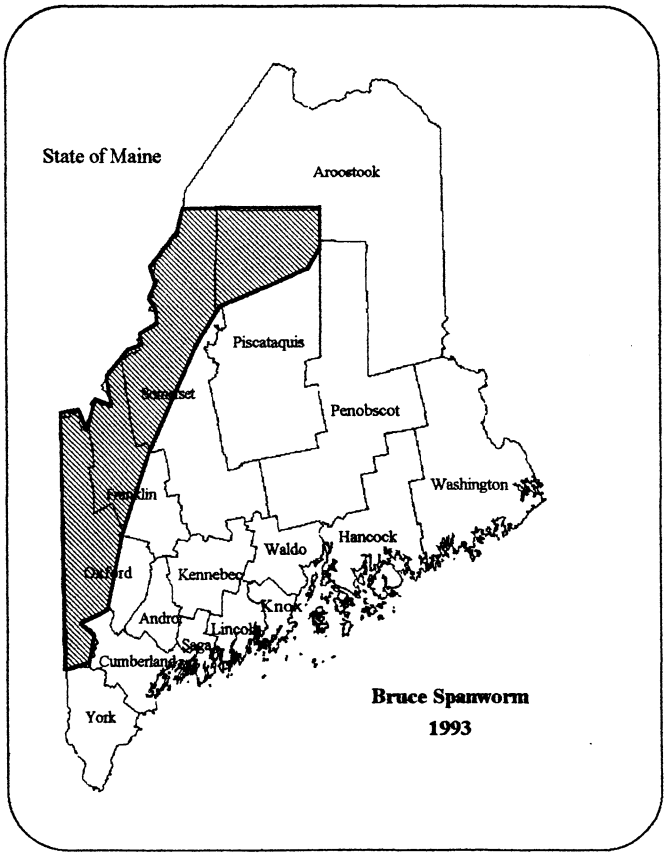

Figure 7

Fall Cankerworm (*Alsophila pometaria*) - Populations of this species throughout most of the state fell in 1993 and numbers of reports of incidence were down as well except in eastern Aroostook County (Figure 8). Severe defoliation of boxelder (Manitoba maple) was common and widespread in eastern Aroostook but because boxelder occurs mainly around homes there, defoliation seemed more widespread than it really was. No woodland infestations were found and surprisingly little defoliation was seen on any other host, even elm and oak!

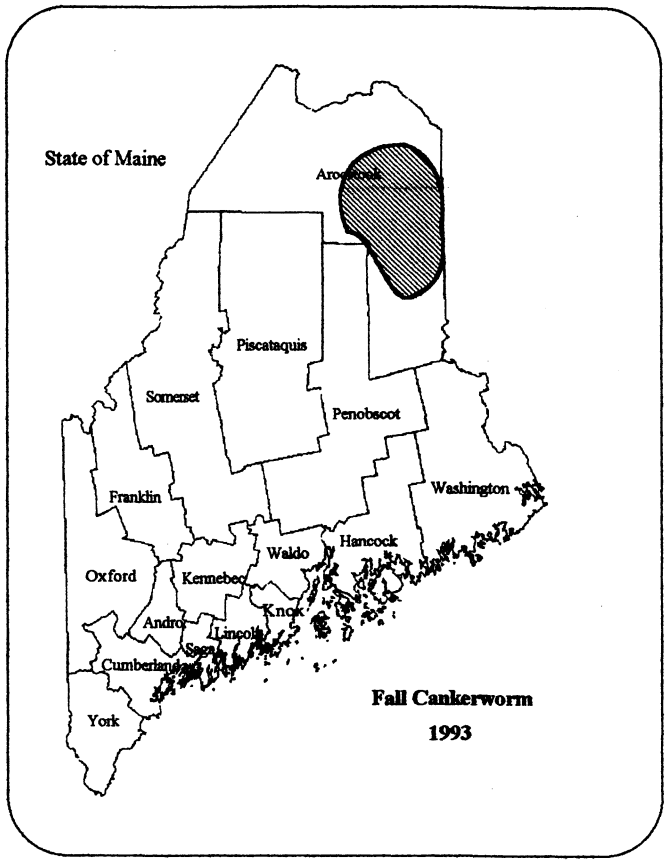

Figure 8

Fall Webworm (*Hyphantria cunea*) - Defoliation by larvae of this species declined in 1993 in most areas of the state except for southwestern Maine (Figure 9). Highest populations and the most serious damage occurred in York and Cumberland Counties.

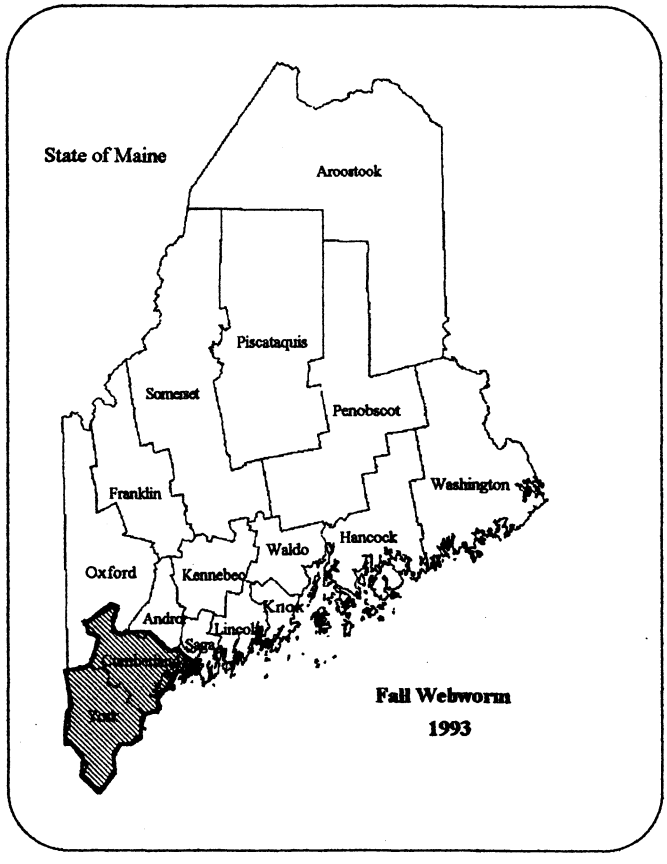

Figure 9

Forest Tent Caterpillar (*Malacosoma disstria*) - No defoliation by this species was reported in 1993 although moth catches in our light trap survey were up in total and in 14 out of 23 of the traps (Table 7).

Table 7. Total number of forest tent caterpillar (*Malacosoma disstria*) moths collected at light

	Year					
Location	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Allagash	93	155	65	39	54	78
Ashland	95	163	110	122	124	169
Blue Hill	16	4	20	27	43	47
Brunswick	105	155	54	69	17	9
Calais			7	11	23	279
Chesuncook			0	0	1	0
Dennistown	76	34	45	37	58	44
Elliotsville	148	39	36	49	78	55
Exeter		5	1	1	2	1
Greenbush	85	67	44	56	24	30
Guerette	31	12	20	28	8	12
Haynesville		68	45	56	36	45
Kingfield	24	16	1	4	18	20
Matagamon	123	175	46	63	126	56
Millinocket	35	20	14	20	43	7
Mt. Vernon	72	54	39	32	107	39
North Bridgton	476	289	90	115	153	297
Rangeley		8	1	81	47	48
South Berwick	256	198	245	352	324	377
St. Aurelie	6	1	6	18	13	9
Steuben		11	8	9	0	2
Topsfield	53	84	33	28	45	102
Washington	163	27	31	23	36	53
Total # Moths	1,857	1,585	961	1,240	1,380	1,779
Total # Traps	17	21	23	23	23	23

Greenstriped Mapleworm (*Dryocampa rubicunda*) - Populations of this species remained extremely low again in 1993 with no noticeable defoliation reported. It is primarily a feeder on red maple in Maine. Numbers of the medium-sized attractive, pink and yellow moths (the rosy maple moth) rose slightly in 1993 for the second consecutive year (Table 8).

Table 8. Total number of greenstriped mapleworm (*Dryocampa rubicunda*) moths collected at light

	Year					
Location	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Allagash	0	0	0	0	0	2
Ashland	0	0	0	0	0	1
Blue Hill	57	82	115	24	46	104
Brunswick	19	12	20	13	16	4
Calais			20	7	4	13
Chesuncook			10	4	1	3
Dennistown	0	0	1	0	1	1
Elliotsville	69	8	58	7	11	14
Exeter		11	6	1	1	3
Greenbush	21	15	16	10	12	13
Guerette	0	0	0	0	0	0
Haynesville		2	5	8	2	8
Kingfield	0	1	0	0	0	0
Matagamon	0	0	0	0	0	0
Millinocket	74	43	61	8	27	38
Mt. Vernon	2	3	2	24	18	5
North Bridgton	14	3	2	4	6	2
Rangeley		0	0	0	0	1
South Berwick	16	16	95	41	373	340
St. Aurelie	0	0	0	0	0	0
Steuben		28	14	42	84	22
Topsfield	8	25	17	20	12	31
Washington	22	70	7	89	48	90
Total # Moths	302	319	449	302	662	695
Total # Traps	17	21	23	23	23	23

Gypsy Moth (*Lymantria dispar*) - Populations continued to decline in Maine in 1993. Aerial surveys delineated 50,694 acres of forested type which received some degree of defoliation, all in York County (44,330 A. moderate to heavy, 6,364 A. light defoliation). This is the second consecutive year of decline from the high 1991 levels. For further discussion on gypsy moth see pages 51 and 53.

The **Asian gypsy moth**, a different race of the same species, is generating special concern. This race has a broader host range and, because the females fly, has the potential to spread faster and be less easily managed. This race is now established in some parts of western Europe as well as Asia. Some individuals were inadvertently introduced into Washington and Oregon in 1992 and into North Carolina in 1993. Eradication efforts are underway. Although none of these introductions were associated with the importation of forest products, a shipment of lumber from Western Russia to Searsport this past year underscored such concern. The I&DM Division and USDA-APHIS staff continue to monitor and assess the risk of introduction.

Hemlock Looper (*Lambdina fiscellaria*) - Damage to hardwoods, even birch in infested stands, was barely detectable in 1993.

Hunter's Moths (adults of several species of cankerworms) - There are several species of fall flying moths which begin their flight activities just after the hemlock looper moths finish theirs. These male moths (females are wingless) tend to fly from mid October through November (hunting season in Maine) and due to the colder temperatures at that time of year do so mainly on sunny days and on warmer nights. Of several possible species, the **Bruce spanworm** and **fall cankerworm** are the most common. Bruce

spanworm moth activity was again common in the fall of 1993 and often striking especially in northern hardwood stands in northern and western Maine. Fall cankerworm moths were common in eastern Aroostook County and along the Penobscot River south to Bangor but numbers were not as noticeable as expected. Moths of both species occurred in low numbers elsewhere throughout the state.

Large Aspen Tortrix (*Choristoneura conflictana*) - Populations of this species continue to defy predictions and defoliation by larvae declined sharply in 1993 to 900 acres from roughly 22,000 acres in 1992. Previous defoliation figures ran from 12,000 acres in 1990 to less than 500 in 1991. These figures all apply to moderate to heavy defoliation picked up through aerial surveys. One of the reasons for this fluctuation appears to be associated with shifting populations across the northern half of the state. In 1992 much of the defoliation was in poplar stands in western Aroostook County along with fairly chronic but somewhat shifting populations which have occurred for the past five years or so in west central Somerset County. Most of the defoliation in 1993 was in small pockets within the central Somerset County area (Figure 10). Moth catches in our light trap survey also declined again in 1993 for the third consecutive year indicating a possible downward trend in populations overall (Table 9).

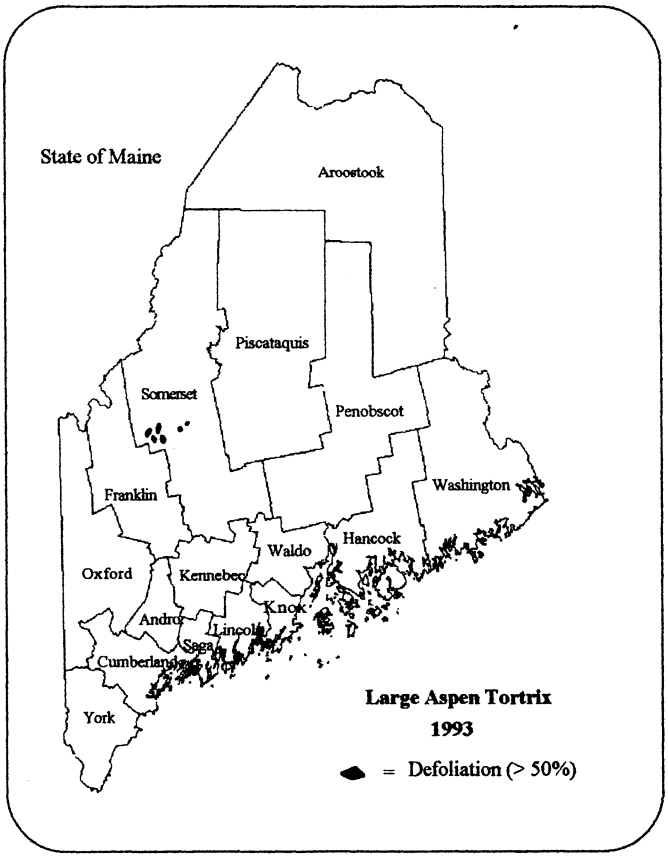

Figure 10

Table 9. Total number of large aspen tortrix (*Choristoneura conflictana)* moths collected at light

	Year			
Location	**1990**	**1991**	**1992**	**1993**
Allagash	13	1	0	5
Ashland	10	0	0	0
Blue Hill	0	3	14	2
Brunswick	0	0	3	0
Calais	6	14	2	0
Chesuncook	0	0	0	
Dennistown	974	0	0	2
Elliotsville	159	33	42	14
Exeter	0	5	4	15
Greenbush	2	25	28	29
Guerete	0	1	0	0
Haynesville	15	257	3	0
Kingfield	2	0	3	0
Matagamon	0	0	3	0
Millinocket	11	14	5	0
Mt. Vernon	1	4	2	2
North Bridgton	0	0	2	0
Rangeley	1	5	47	92
South Berwick	0	3	4	0
St. Aurelie	8	0	0	1
Steuben	0	4	2	1
Topsfield	42	20	15	1
Washington	0	0	14	0
Total # Moths	**1,244**	**389**	**193**	**164**
Total # Traps	**23**	**23**	**23**	**23**

The I&DM Division regularly monitors populations of, and damage from, the large aspen tortrix. A survey in June of 1992 of one trembling aspen stand in Pierce Pond Twp. produced an interesting assemblage of associated species, some of which have only recently been identified (Table 10). The high incidence of spiders, ground beetles (*Calosoma*) and parasitic wasps were indicative of a declining population. Other areas nearby showed similar activity in 1993.

Table 10. Species associated with the large aspen tortrix in Pierce Pond Twp. on June 2, 1992

Hymenoptera:	Several species.	Many appeared to be parasites seeking hosts.
Lepidoptera:	*Choristoneura conflictana.*	Larvae mature, out of food and spinning down.
	Nymphalis antiopa (Mourning Cloak).	Adults common.
	Papilio canadensis Canadian Tiger Swallowtail).	Butterflies very common and clustered at puddles.
Predators		
Coleoptera: Carabidae	*Calosoma frigidum* (Ground beetles).	Abundant
Arachnida:(Araneae; Spiders)		Identified by Dr. Daniel T. Jennings.
Lycosidae: (Wolf Spiders).		Most common group - many running over ground litter.
	Gladicosa ? sp.	1 juvenile.
	Pardosa mackenziana (Keyserling).	2 males.
	Pardosa sp.	1 penultimate male (probably *mackenziana*).
Salticidae: (Jumping Spiders)	*Phidippus whitmani* Peckham & Peckham.	1 male.

Maple Leafroller (***Sparganothis acerivorana***) - Populations of maple leafroller remained very low again in 1993 and little defoliation of red maple was observed even in areas of Hancock County where defoliation had previously been heavy.

Oak Leaf Shot-Hole (caused by *Japanagromyza viridula*) - This problem which was so prevalent and obvious in 1991 was all but absent in 1993 for the second consecutive year. This appears to be due to a lack of coincidence of emerging flies with vulnerable stages of host leaf development. The need to have both host and pest in "sync" to have significant damage occur is especially critical for pests such as this, as well as **pear thrips** on sugar maple. Both of these insects can survive without this synchronization but damage is minimal.

Oak Leaftier (Shredder) (***Croesia semipurpurana***) **and Oak Skeletonizer** (***Bucculatrix ainsliella***) - Significant defoliation by either of these two species was not detected in 1993 even though we had speculated that populations were headed upward in last year's summary. Very localized infestations of the leaftier were, however, reported in Kennebec County.

Oak Twig Pruner (***Elaphidionoides villosus***) - Populations of the oak twig pruner remained fairly stable at low levels for the eighth consecutive year. Damage to individual trees, however, was occasionally heavy.

Orangehumped Mapleworm (***Symmerista leucitys***) - It was again difficult to find larvae of this species in most areas in 1993 and even more difficult to find signs of feeding damage. Light trap collections of moths of this and related species (*Symmerista* spp.) were also down for the fourth consecutive season in 1993 (Table 11).

Table 11. Total number of *Symmerista* spp. moths collected at light

	Year					
Location	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Allagash	0	0	0	0	0	0
Ashland	1	0	0	0	0	0
Blue Hill	2	2	0	0	1	6
Brunswick	81	31	4	8	0	1
Calais			5	1	3	0
Chesuncook			1	0	0	1
Dennistown	1	0	0	1	0	0
Elliotsville	285	155	44	10	5	4
Exeter		20	0	1	0	1
Greenbush	50	70	3	0	0	0
Guerette	0	0	0	0	0	0
Haynesville		12	1	0	0	0
Kingfield	8	11	0	0	0	0
Matagamon	2	7	2	0	0	0
Millinocket	342	211	9	0	0	0
Mt. Vernon	28	28	3	2	4	4
North Bridgton	35	14	3	10	8	21
Rangeley		0	0	1	0	0
South Berwick	45	32	18	13	30	4
St. Aurelie	0	0	0	0	0	0
Steuben		6	0	7	0	0
Topsfield	72	362	67	5	3	0
Washington	25	20	3	6	9	10
Total # Moths	**977**	**981**	**163**	**65**	**63**	**52**
Total # Traps	**17**	**21**	**23**	**23**	**23**	**23**

Oystershell Scale (*Lepidosaphes ulmi*) - Populations of this scale on beech remained endemic in 1993. Damage from this and other pests such as **beech scale/nectria**, however, continues to be obvious in most stands.

Pear Thrips (*Taeniothrips inconsequens*) - No damage from pear thrips feeding was reported in 1993 and populations were barely detectable. Sticky trap surveys yielded very low numbers.

Saddled Prominent (*Heterocampa guttivitta*) - No damage or larvae were observed in 1993. Moth catches in the light trap survey declined noticeably during the period (Table 12).

Table 12. Total number of saddled prominent (*Heterocampa guttivitta*) moths collected at light

	Year					
Location	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Allagash	14	13	8	4	1	3
Ashland	0	1	0	0	0	0
Blue Hill	1	0	6	2	1	1
Brunswick	18	10	42	34	0	0
Calais			2	4	3	0
Chesuncook			51	10	12	13
Dennistown	0	4	1	3	0	0
Elliotsville	2	3	6	5	4	4
Exeter		13	29	5	10	0
Greenbush	2	1	0	1	1	1
Guerette	0	0	0	1	0	0
Haynesville		3	0	0	0	1
Kingfield	2	1	0	0	1	0
Matagamon	4	3	7	0	1	0
Millinocket	7	13	10	21	10	5
Mt. Vernon	13	17	21	32	19	1
North Bridgton	5	1	0	41	15	9
Rangeley		0	0	10	4	0
South Berwick	14	5	29	15	53	3
St. Aurelie	0	0	3	0	0	0
Steuben			4	3	17	28
Topsfield	0	4	7	5	11	4
Washington	3	79	3	50	23	1
Total # Moths	**85**	**171**	**229**	**246**	**186**	**74**
Total # Traps	**17**	**21**	**23**	**23**	**23**	**23**

Satin Moth (*Leucoma salicis*) - Satin moth larval defoliation declined from roughly 2,600 acres in 1992 to 1,430 acres in 1993. Infestations in southern Washington and Hancock Counties all but disappeared but slight increases were noted in central Penobscot (620 acres) and Piscataquis (810 acres) Counties (Figure 11). Moth catches in the light trap survey remained low and fairly stable (Table 13).

Scattered defoliation of ornamental and shade tree eastern cottonwood and white poplar did appear to be prevalent again in 1993, especially white poplar in Chesterville, Farmington and New Sharon in Franklin County and Vienna in Kennebec County. Some declines were observed however even in these areas.

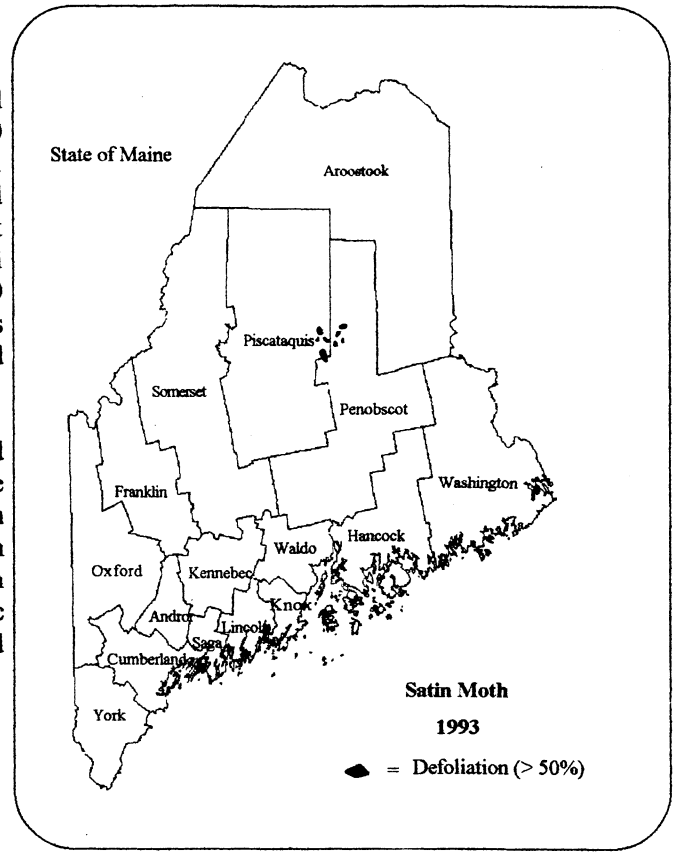

Figure 11

Table 13. Total number of satin moth (*Leucoma salicis*) moths collected at light

	Year					
Location	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Allagash	5	11	3	3	2	2
Ashland	13	5	5	0	7	3
Blue Hill	0	0	0	0	0	0
Brunswick	4	0	2	0	0	2
Calais			6	5	0	0
Chesuncook			0	0	0	1
Dennistown	4	0	2	3	15	0
Elliotsville	1	0	0	1	5	2
Exeter		0	0	0	0	0
Greenbush	13	9	1	2	0	0
Guerette	0	24	4	3	3	16
Haynesville		1	3	0	2	18
Kingfield	2	0	0	0	1	0
Matagamon	4	0	0	0	0	0
Millinocket	1	1	1	5	17	3
Mt. Vernon	0	0	0	0	0	0
North Bridgton	0	0	0	0	0	0
Rangeley		0	0	4	1	0
South Berwick	0	0	0	0	1	1
St. Aurelie	0	0	0	0	0	0
Steuben		4	41	22	2	2
Topsfield	0	2	1	3	0	3
Washington	0	0	0	0	0	0
Total # Moths	**47**	**57**	**69**	**51**	**56**	**53**
Total # Traps	**17**	**21**	**23**	**23**	**23**	**23**

Tussocks (several species) - There are several species of tussock moth caterpillars which have been occasionally abundant on trees in Maine. Most have caused only minor defoliation in Maine, if any, however these fuzzy and often colorful characters seem to attract attention. Their hairs can also cause skin irritation especially during periods of hot weather and "caterpillar" rash is not uncommon. One report of noticeable numbers of **hickory tussock caterpillars** (*Lophocampa caryae*) was reported from basswood in several areas covering roughly 10 acres in Monroe (Waldo County) in 1993. This species may be confused with fall webworm when young and gregarious but as they grow they feed individually and are strikingly white and black marked. Other tussocks are olive grey, black and yellow or other color combinations but always fuzzy and most often with contrastingly colored tufts (tussocks) of hair.

Variable Oakleaf Caterpillar (*Lochmaeus manteo*) - Populations of variable oakleaf caterpillar continued to decline in all previously infested portions of the state but larvae and light damage could still be found in many areas. One area in T5 R1 (east central Penobscot County) received moderate defoliation on 45 acres of beech. Defoliation was apparent from the ground but the damage was on lower branches and did not show from the air. The general trend for this insect has been downward for the last three years. Moth catches from the light trap survey continued to decline as well (Table 14).

Table 14. Total number of variable oakleaf caterpillar *(Lochmaeus manteo)* moths collected at light

	Year					
Location	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
Allagash	0	0	0	1	1	0
Ashland	0	0	7	10	6	0
Blue Hill	0	0	7	4	5	0
Brunswick	3	80	4	2	0	0
Calais			2	4	3	0
Chesuncook			0	1	0	0
Dennistown	3	2	7	7	0	0
Elliotsville	19	37	87	175	42	5
Exeter		40	9	7	0	0
Greenbush	12	56	49	39	3	0
Guerette	0	1	2	1	0	0
Haynesville		15	94	86	21	6
Kingfield	49	70	192	158	14	0
Matagamon	0	10	17	13	1	0
Millinocket	51	276	169	310	122	85
Mt. Vernon	10	9	0	2	0	2
North Bridgton	0	4	5	6	0	0
Rangeley		1	5	3	0	0
South Berwick	16	14	11	15	3	8
St. Aurelie	0	1	0	0	0	2
Steuben		8	3	3	0	0
Topsfield	27	114	316	302	250	83
Washington	54	21	23	2	1	0
Total # Moths	**244**	**759**	**1,009**	**1,151**	**472**	**191**
Total # Traps	**17**	**21**	**23**	**23**	**23**	**23**

Willow Flea Weevil (***Rhynchaenus rufipes***) - Populations of this pest were extremely high in 1993 and mining of foliage by the larvae gave trees a bronzed sheen when viewed from a distance in August over much of the southern half of the state. While damage was heaviest on willows, especially black and weeping willow, defoliation of balsam poplar was also heavy and striking where the trees occurred adjacent to willows. The tiny black, bead-like adults with their orange legs were all over everything in infested areas in August, even laundry, hair and picnic lunches. They were often confused for ticks! Populations were the highest seen in many years. Damage appears to have been primarily aesthetic so far.

Woolly Alder Aphid (***Prociphilus tessellatus***) - This common component of our alder thickets also occurs on silver maple. For some reason populations on silver maple foliage have not been common or consistent over the years even though aphid populations on alder stems have often been high. The 1993 season was the exception and silver maple in many parts of Kennebec and Oxford Counties "sported" high numbers of aphids. Honeydew from aphid feeding coated many objects beneath infested trees with a sticky coating and "nested" leaves were highly visible in many cases. During mid July many of the "nested" leaves dropped and strands of white wool coated everything as the aphids blew off in winds and rain and left the maple for the alder. While damage to maple has generally been considered minor in Maine, this species can be a nuisance as well as a curiosity.

(C) Shade Tree, Ornamental and Miscellaneous Insect (and Other Arthropod) Pests (See also Sections A and B)

Alder Flea Beetle (*Altica ambiens alni*) - "Scorched," browned alder were a common sight again in 1993 at least over much of southern Maine. The problem was again somewhat "patchy" but populations seemed to hold roughly at 1991 levels for the third consecutive year. Reports of the shiny, metallic blue adults during the fall were down in number signifying that either populations may be in for a decline or everyone is getting used to seeing them.

Ant Swarms - Massive ant swarms were again reported from a number of localities in August. While a few came to the attention of hikers when swarms settled on mountain tops and ridges, most became obvious when they came down over water and washed up on the beach. One such noticeable swarm was reported from the shore of Damariscotta Lake. Ant swarms are also visible in the air often resembling clouds at a distance.

Ash Flowergall Mite (? *Aceria* (= *Eriophyes*) *fraxiniflora*) - This problem is caused by a tiny, worm-like, eriophyid mite which we suspect is *A. fraxiniflora*. These mites breed and feed within clusters of the male ash flowers and flower buds and cause noticeable proliferation of the buds and some bud shoot deformation. In past years this problem has been relatively local and insignificant but over the past two or three years we have seen tremendous populations of the so-called galls (large clumps or clusters of buds) and have even associated this phenomenon with light to moderate twig and branch mortality. No whole tree mortality has yet been reported. The worst problem appears to be from roughly Kennebec County southward. Apparently only white ash is affected and the literature would indicate that only male trees are affected (white ash is dioecious-sexes on separate trees). Because we have done little to assess the problem up until now there is little information available. Originally we had thought that the problem would be worse in flowering years but have since found mites and damage in consecutive years. Yet unidentified fungi have also been found to be associated with any dieback. Many trees have low numbers of mites on them so why there are population explosions on some trees we are not sure. There is one situation in Belgrade where the problem seems to have moved from one tree to another, spreading at the rate of several new trees a year. The nature and significance of this problem will require further study.

Bagworm (*Thyridopteryx ephemeraeformis*) - Although this species has not become established this far north, we frequently find one or more "bags" on imported nursery stock from the south. This season, Me. Dept. of Agr. personnel found infested nursery stock from Pennsylvania which included enough active individuals to cause noticeable defoliation of some of the stock in one location in Kennebec County. The problem was held in check through early detection and treatment.

Bark Lice (Psocoptera) - No reports of the usual herd-like activity of these interesting and benign little creatures on tree bark were received in 1993.

Cockroaches (*Ectobius* spp.) - Outside flying cockroaches in Maine?! We don't have any! Wrong. There are several species of wood roaches in Maine, most of which remain secluded and not a problem. In recent years, however we have seen the rise of three species of imported roaches in the genus *Ectobius* all of which appear similar. Two of these, *E. pallidus* and *E. sylvestris*, have been reported from coastal areas from Belfast west to Kittery. This season we recorded a third species, *E. lapponicus*, from the Blue Hill area. These cockroaches somewhat resemble very pale and frail german cockroaches but unlike their bad acting counterpart, these outdoor cockroaches prefer the woods and fields. Unfortunately they come to lights in numbers at times, as they have in Blue Hill and at such times may enter buildings albeit briefly.

In Blue Hill both male and female adults and nymphs of *E. lapponicus* were common on the foliage of alder which were heavily infested with the **woolly alder aphid** *Prociphilus tessellatus*. They appeared to be feeding on honeydew.

Dogwood Sawfly (*Macremphytus* spp.) - Defoliation of native dogwood by larvae of one or more species of these sawflies was spotty during 1993 and probably would not have attracted attention except that in some cases larvae sought out and bored into the siding of adjacent homes to pupate. This problem varies from year to year and place to place but occurs most often in central and southern Maine on alternate-leaved, red osier and silky dogwoods.

Eastern Tent Caterpillar (*Malacosoma americanum*) - Some roadside cherry in southern Maine were literally stripped by these caterpillars this season and it was not uncommon to see six to ten tents on a single bush! Populations were up slightly from 1992 levels.

Euonymus Caterpillar (*Yponomeuta* sp. prob. *cagnagella*) - Larvae of this species were active again at least in the Bangor-Orono area where some tree-type euonymus were stripped.

Hydrangea Leaf-Tier (*Exartema ferriferanum*) - This pest was more abundant this year than usual. The pale green larvae neatly tie two leaves together edge to edge, forming a pocket around the terminal flower buds where they feed protected from sprays. Significant flower reduction can occur.

Japanese Beetle (*Popillia japonica*) - Japanese beetles appeared on schedule this past season. The first report from Scarboro was on June 25 and from Augusta on July 5. Populations remained especially heavy in Kennebec County and reports of local hot spots were also received from Androscoggin, York and Cumberland Counties. Populations occurred in other areas as well at least as far north as the Bangor area although populations did appear to be down somewhat in fringe areas. Although these beetles eat just about any foliage, they seem to prefer little-leaf linden, roses, raspberries, grapes and Japanese knotweed (also known as bamboo).

Locust Leafminer (*Odontota dorsalis*) - Larval mining of black locust foliage by this species was extensive again this season at least in Lewiston where infested trees along Stetson Brook appeared rusty red in color by late July. Populations elsewhere from Bangor south and west were variable but were generally lighter than in 1992.

Medical Entomology - Maine state government does not have a designated medical entomologist position. As a result MFS-I&DM staff still receive requests for advice and assistance in dealing with an array of insect and other arthropod related problems. Included in these requests are questions relating directly to such things as **black flies, bot flies, deer flies, horse flies, mites, mosquitoes, spiders, stinging insects** and **ticks**. Also included are vector related disease problems such as **eastern equine encephalitis, heartworm** and **lyme disease** and a series of **allergies, rashes** and **reactions**. As in the past, the actual numbers of requests are not high but individual concern is often great. Disease questions *per se* are referred to specialists.

Biting fly populations in 1993 ran very close to those of 1991-92 in severity but with some seasonal changes. Requests for advice and assistance also ran close to the level encountered during the same period. There did appear to be increased interest in alternative methods of control such as the **dragonfly-mosquito** project in Wells. Several reports were also received concerning what appeared to be unusually severe reactions to **black fly** bites.

The number of complaints concerning **stinging insects** fell again in 1993 for the second consecutive year since the high 1991 levels.

Reports of **rashes** associated with the hairs of caterpillars such as the **browntail moth** increased as populations of this species continued to plague inhabitants of coastal islands in Casco Bay. Problems associated with other fuzzy caterpillars such as the **tussocks** and **gypsy moth** were down in 1993.

Spiders (various) - We annually receive specimens of spiders and questions about them. Personal awareness and concern was heightened in 1993 following an article in Readers Digest. Most concerns centered on the possibility of poisonous spiders in Maine and prompted a rash of calls and specimens most of which were common native species. So far as we know there are no poisonous spiders indigenous to Maine. However, we do occasionally encounter both the infamous **widow spiders** (*Latrodectus* spp.) and the **brown recluse** (*Loxosceles reclusa*) in Maine but always associated with goods and materials brought in from other parts of the country. Neither of these species has become established in Maine except very briefly within single buildings and populations have been quickly eliminated. It is doubtful that any of these poisonous species survive in Maine outdoors although the **northern widow** (*Latrodectus variolus*) could possibly do so. There may, however, be one or two introduced species which occur in homes which could inflict bites which under some circumstances would produce a more serious reaction than native species. These are being investigated elsewhere by specialists. The poisonous species mentioned are most often small (<1/2" body length). The occasional serious reaction to a spider bite could be due to individual sensitivity to a native species or a complex interaction of native spider bite venom with a particular medical treatment. Several spider bite complaints were investigated by health officials in 1993 and treated by physicians.

Most reports during the summer months concern the large fishing spider known as the **dark Dolomedes** (*Dolomedes tenebrosus*). These spiders are nearly 1" long in body length or 2-3" long with legs extended. They are lightly hairy with banded legs and have variable "W" shaped marks on their backs. Females especially seem to seek out dark corners of buildings and cellars in which to hide. They are hunters and are active mostly at night. They are shy and usually prefer to run than bite. They can however bite and although the bite may be painful it is not considered poisonous. Let them go as they are more beneficial as predators than harmful.

As fall approaches the attention seems to shift to the **garden spiders** (especially the **black and yellow garden spider**, *Argiope aurantia*) which have become obvious as they extend their large orb webs between weeds and garden plants. After cold weather begins to set in, it is the **grass spiders** (*Agelenopsis* spp.) which then begin moving into homes, often end up in tubs and sinks.

Ticks (Ixodidae) - The number of ticks received for identification in 1993 (202) was similar to that of 1992. Populations of adults of the **American Dog Tick** (*Dermacentor variabilis*) in June and July appeared to be lower and more local in 1993 and occurred primarily in southern Maine. Population shifts to the north and east appeared to continue although it was not as obvious. Larvae of the **moose** or **winter tick** (*Ixodes albipictus*) again appeared in November in some areas but numbers and stories about them did not appear as striking as in 1992. Increasing numbers of people now apparently feel that they can accurately separate these species from the **lyme** or **deer tick** (*I. dammini*) which is of more concern. Deer tick records increased slightly in

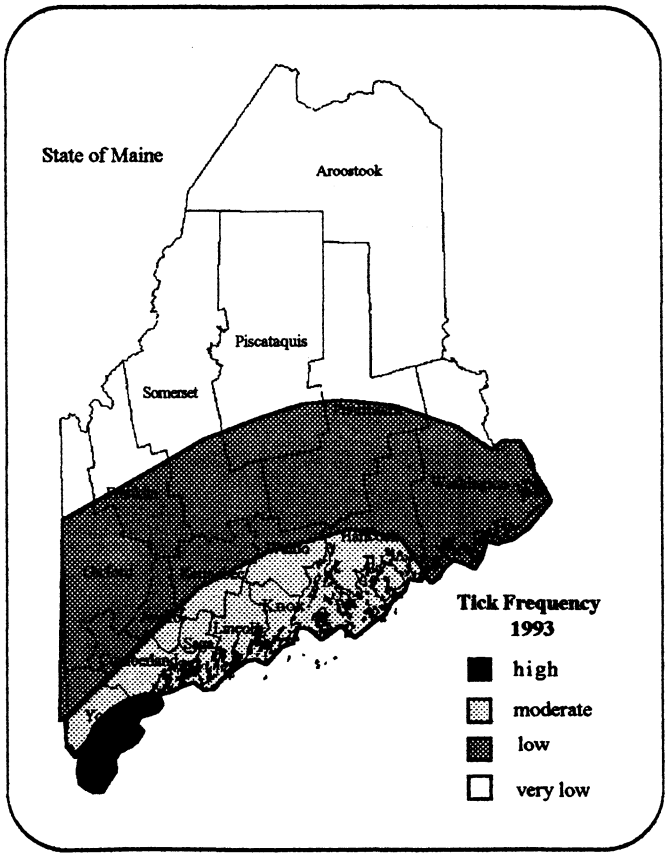

Figure 12

number in the spring of 1993 but dropped off sharply as the season progressed. Minor range extensions were observed. Ticks in Maine are still more common in the southern part of the state (Figure 12).

Lyme disease in Maine - The lyme disease status changed little in 1993 (17 confirmed cases in 1992 and 18 in 1993). Roughly 80 cases in total have now been offically recognized from Maine. Several cases from inland areas in Androscoggin and Kennebec Counties failed to meet CDC requirements for verification.

Miscellaneous Problems - Each year the I&DM staff handle well over 1,000 different requests for advice and assistance in addition to specific surveys and project work. Table 15 gives a breakdown of most of the problems handled by Augusta laboratory personnel in 1993 showing some of the diversity of requests.

Table 15. Number of requests received in 1993 for advice and assistance about forest, shade tree and ornamental pests.

Problem	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Aphids	1				1	2	6	1		1			12
Balsam twig aphid				2	10		1						13
Bark beetles	1				1			1	1				4
Birch leafminers								1					1
Browntail moth					6	6	2			1			15
European larch canker	1	1	2	1	1	1	2	2	2	2	2	2	19
Fall webworm							1	2					3
Galls					3	7	1	2	2				15
Gypsy moth	1	2	8	12	24	7	2	2	2	7	1		68
Hemlock looper		1	3	1	2	1							8
Hemlock woolly adelgid		3		1			1	4	1		1		11
Japanese beetles			1		1	2	2	3	1				10
Mites						3	1	5					9
Sawflies				2		3	6	6	2	1			20
Spruce budworm	1				1								2
Tent caterpillars					3	3							6
White pine blister rust			6	7	8	6	7	10	6				50
White pine weevil			1	5	1	2		1	2				12
Woodborers			2	3	2	4	2	5	2	1	1		22
Other requests	44	39	76	117	114	192	184	169	100	61	26	8	1,130
Total	**49**	**46**	**99**	**151**	**178**	**239**	**218**	**214**	**121**	**74**	**31**	**10**	**1,399**

Mountain Ash Sawfly (***Pristiphora geniculata***) - Larvae of this species stripped the foliage from branches of infested mountain ash locally throughout southern Maine again in 1993.

Oriental Beetle (***Anomala orientalis***) - This introduced species which is most often associated with nursery stock was found this year in Winthrop. The only other area in Maine where it has been found so far is in Gorham. Both records were reported by Richard Folsom of the Me. Dept. of Agr.

Rose Chafer (***Macrodactylus subspinosus***) - Populations of this species remained low again in 1993 with a few local "hot spots." High populations of rose chafers can strip greenery from everything from ferns to trees. These tawny, spidery looking native beetles occur earlier (June) than Japanese beetles although their damage in some cases is every bit as severe.

Seed Bugs - In the fall of 1993 we again received complaints from homeowners who were "plagued" by various seed (their favorite food) bugs. The three most commonly encountered were: the **box elder bug** (*Leptocoris trivittatus*) in the Sanford area; the **lesser milkweed bug** (*Lygus kalmii*) throughout southern Maine wherever milkweed is found; and the **birch catkin bug** (*Kleidocerys resedae*) statewide (page 20).

DISEASES and INJURIES Associated With Trees in 1993

Air Pollution Injury (caused by various air contaminants, especially ozone) - Symptoms of ozone damage to certain species of forest trees were greater last summer than in 1992, but nowhere nearly as bad as in 1988, when we encountered the worst damage in recent memory. Symptoms were nevertheless common on white ash, black cherry, and to a lesser extent, white pine in Maine in 1993.

Air pollution injury to forest vegetation in general is much less pronounced now than it was in the sixties and early seventies, probably due to a general reduction in sulfur dioxide emissions by industry in the northeastern United States. But there is still the potential for summers with high levels of ozone injury to vegetation due to the capriciousness of weather systems. Unlike sulfur dioxide which acts directly and tends to be produced in finite amounts by industry, ozone is produced over time by the action of sunlight on certain by-products of combustion. Weather conditions can vary to produce either relatively little or great quantities of ozone depending on the sunlight, humidity, and temperature regimes which exist as air masses pass through the state during the growing season.

Annosus Root Rot (caused by *Heterobasidion annosum* syn. *Fomes annosus*) - Every year we seem to confirm the presence of annosus root rot at one or more previously unreported sites. Last year was no exception. A plantation of red (Norway) pine had been opened in the back yard of a Topsham residence some years ago to allow the construction of an in ground swimming pool. In addition to the removal of trees to accomodate the pool, a few adjacent trees were cut to admit sunlight but the resulting stumps were not treated with borax. They shortly became infected by the Annosus root rot organism (*Heterobasidion annosum*) which subsequently spread through root systems to infect nearby healthy trees. As a result the landowner has more sunlight in her pool area than she intended. Worse, since infected standing trees tend to fall easily due their rotted root systems, many remaining trees had to be removed for safety reasons.

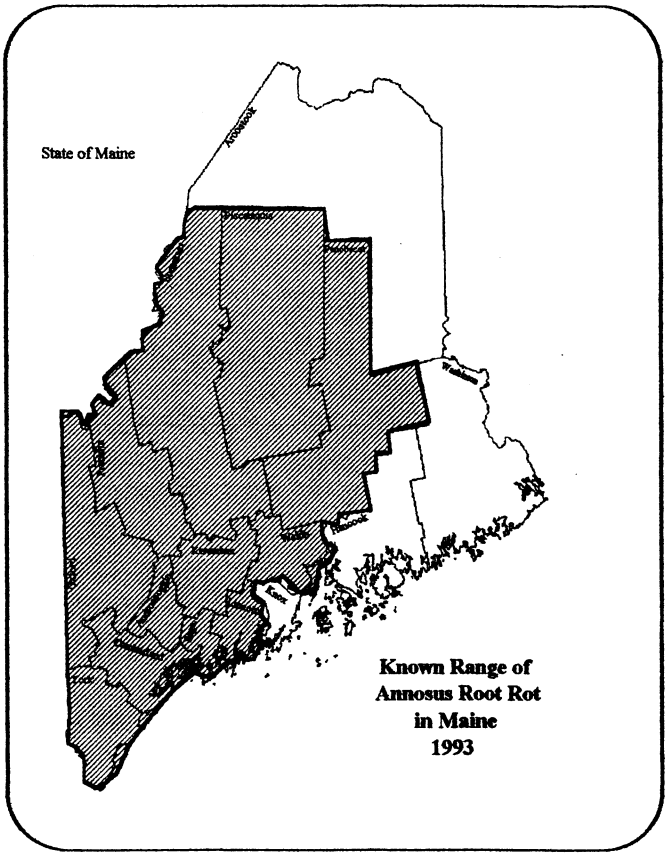

Figure13

This is primarily a disease of plantation pine in Maine. To date we have recorded infected plantations in the following counties: Androscoggin, Cumberland, Franklin, Kennebec, Lincoln, Oxford, Penobscot, Piscataquis, Sagadahoc, Somerset, Waldo, and York.

Armillaria Root Rot (caused by *Armillaria* spp.) - This disease, known also as shoestring root rot, is caused by an opportunistic fungus which may attack and kill hardwood and softwood trees of all ages. Where softwoods are infected, the disease organism involved is usually *A. ostoyae*. This organism frequently infects balsam fir, black spruce, and red spruce in Maine, and is a contributing factor to the "sudden death" of balsam fir known as Stillwell's Syndrome. Where hardwoods are infected, a different species of *Armillaria* is likely to be involved.

Ash Anthracnose (caused by *Discula* sp.) - Reports of ash anthracnose were down again this year, probably the result of dry weather during normal infection periods. We received specimens from Lincolnville, Lewiston, and Waterville with typical ash anthracnose symptoms, but received no reports of infection from any of our forest health monitoring plots which are located throughout the state.

Ash Leaf and Twig Rust (caused by *Puccinia sparganioides*) - No specimens of this disease were received in 1993 and infection levels appeared to remain low. However, this disease tends to become epiphytotic (epidemic) in Maine every ten years or so and we are now about due for another flare up.

Ash Yellows (caused by mycoplasmalike organisms) - This disease does not occur in Maine as far as we know, though we have not systematically surveyed for it.

Black Knot of Cherry (caused by *Apiosporina morbosa*) - This disease is common in forest situations throughout the state on wild cherry trees and is particularly conspicuous on black cherry where galls a foot or more in diameter may occur. Where these galls occur on the main stem the value of cherry for lumber is considerably reduced. In 1993, we recorded this disease to be present in 15 of 103 forest health monitoring plots. Frequently we receive reports of black knot infections on cultivated cherry or plum trees in landscape or home orchard situations. All too often by the time we are consulted the disease has progressed to such an extent that the usual control practice of pruning knotted twigs and branches to remove infected tissue would essentially reduce the tree to a stump. It is important to diagnose this disease early, prune any knotted twigs each year before April 1, and spray if necessary with the fungicide thiophanate methyl in order to maintain healthy, productive fruit trees.

Boxelder Canker (caused by *Fusarium lateritium*) - This disease, which was very conspicuous in 1991 but barely noticeable in 1992, was again conspicuous in 1993. Stem cankers caused branch mortality on boxelder trees throughout southern Maine, particularly along river valleys, and the resulting "flags" (branches containing brown leaves) were quite noticeable.

For the past two years we were suspicious that late spring frost played a role in the development of this disease, since the 1991 outbreak followed severe spring frosts while in 1992 we experienced neither hard spring frosts nor significant symptom development. But 1993 was one of the mildest years in terms of late spring frost and symptoms were again severe. So much for the frost theory!

Brown Ash Decline (cause unknown but probably stress related) - This disease, which causes dieback and mortality of brown (black) ash (*Fraxinus nigra*), continues to generate attention. While brown ash constitutes less than one percent of the forest trees in Maine, its wood is the preferred raw material for the production of baskets by Native American Indians. Additionally, there is concern that these symptoms may indicate a more pervasive underlying stress to the ecosystem.

Concerned about the future of the Maine's brown ash resource, the Maine Indian Basketmakers' Alliance has established a "Brown Ash Task Force" to address issues related to the resource. The Maine Forest Service has responded to that initiative and to the more general concerns by setting in motion a study to evaluate the extent and severity of the problem, identify causal factors, and provide owners and users of the Maine's brown ash resource with the findings of that investigation. During 1993 the I&DM Division established and measured 57 plots across the northern 2/3 of the state to survey the extent and intensity of damage. Overall, 38% of the plot trees were either dead or dying back, and more than 50% had more than 20% of the crown dead. The Division is coordinating a collaborative evaluation effort with the University of Maine and the USFS to assess the role of various biological and environmental agents in this decline.

Bud Abortion of Balsam Fir (caused by low ambient air temperatures prior to budbreak) - This symptom was uncommon during the spring of 1993 due to relatively mild temperatures throughout the period of bud expansion prior to budbreak.

Butternut Canker (caused by *Sirococcus clavigignenti-juglandacearum*) - Butternut canker, a disease which has virtually eliminated butternut in the Carolinas, has now been found in Maine. Aware that the disease has been present throughout much of the natural range of butternut for several decades now, and was more recently found to be a serious problem in Vermont, we began to suspect that the disease might also be present in Maine. Accordingly we commenced surveys for this disease during the summer of 1993 and, while time did not permit a full statewide survey, we were successful in locating the disease in Kennebec, Lincoln, Sagadahoc and Waldo Counties.

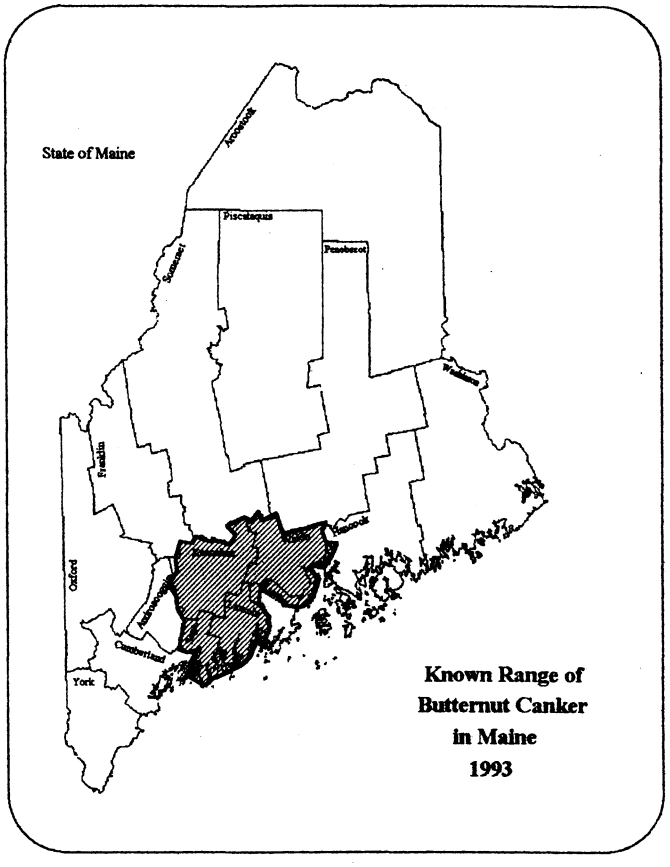

Figure 14

Although the butternut canker organism is extremely virulent to butternut (*Juglans cinerea*), other *Juglans* species are apparently much less susceptible. Black walnut (*Juglans nigra*) is said to be susceptible only if inoculated artificially, and other *Juglans* species have become infected only when grown in close association with severely infected butternut.

Butternut canker is characterized by dying branches and dead tops, epicormic branches, discolored bark which may ooze a thin black inky fluid in the spring, and cankers on the main stem, buttress roots, and branches. When bark in cankered areas is physically stripped away, the sapwood beneath exhibits dark brown, spindle-shaped, stained areas.

No effective controls are available to halt the spread of this disease at this time. Logging injuries should be minimized when harvesting. In nurseries, and perhaps in some homeowner situations, application of fungicides may be appropriate. In some states, butternut harvesting guidelines and even harvesting moratoriums are now in effect. Some persons even feel that butternut as a species is in danger of extinction. There is, however, considerable evidence that resistant trees exist within the native population and, if so, talk of species extinction may be premature.

Caliciopsis Canker (caused by *Caliciopsis pinea*) - This is a generally minor, but occasionally important disease of eastern white pine which is often overlooked. Though we have known about this disease for many years, we are only now becoming aware of it significance and widespread occurrence in Maine. Every year we receive a few inquiries about cankered trees in stagnated white pine stands, and frequently we diagnose Caliciopsis canker as the cause.

Cankers may occur anywhere on tree trunks or suppressed branches and usually occur only in small numbers on a single tree. However, severely attacked trees may contain as many as several hundred cankers. Cankers may be superficial or they may extend into the cambium, killing it.

This is primarily a disease of stagnated stands or suppressed trees in dense stands. It may be effectively managed through judicious and timely stand thinnings.

Chemical Injury (phytotoxicity due to chemical pesticide application) - Growers and landscape managers should be alert to the possible phytotoxic effects of certain pesticides when applied to tender, emerging concentrates, mist blower applications, and/or treatment during hot weather. We have repeatedly warned balsam fir Christmas tree growers to be careful of Diazinon AG 500 and Lorsban 4 E when applying them during late May and early June.

This year we had a report of damage to tender, emerging growth of Norway spruce due to mistblower application of malathion 4 EC in mid-June. Trees and shrubs generally outgrow such damage, but the short term effects can be significant.

Cone Buds - Balsam fir Christmas trees in some plantations set huge numbers of cone buds during the summer of 1993. This means that 1994 will likely be a big cone year, with all the problems that brings for Christmas tree growers. Plantations of Cook strain trees, or those of similar types (bluish color with "double" foliage), are particularly susceptible to this problem.

One might think that cones would only add to a tree's ornamental value. But as fir growers are well aware, fir cones mature and disintegrate prior to harvest leaving behind unsightly spikes. Worse, where cones are produced, green shoots are not produced, which results in unsightly "holes" near the tops of trees after the cones disintegrate. Also, when cone set is very heavy, tops of trees turn yellow rendering affected trees unsaleable. Present indications are that some individual Christmas trees will produce in excess of 100 cones each during 1994.

Growers who need seed will probably have an opportunity to collect it in large quantities in 1994. But growers may want to resist the temptation to collect seed from even the better looking trees in their plantations. Those trees will be "early coners" (trees which tend to produce cones at a young age) and to the extent this trait is heritable, resulting progeny are likely to form cones early as well. Growers are advised to collect seed from good trees in the wild, or ideally from seed orchards where trees form cones at a young age due to grafting rather than any genetic predisposition to early flowering.

Coral Spot Nectria Canker and Steganosporium Dieback (caused by *Nectria cinnabarina* and *Steganosporium* sp., respectively) - These two disease organisms often work in concert to cause dieback and decline in several species of forest and shade trees, especially sugar maple. We seem to have received more calls than usual regarding these diseases in 1993, though the difference may not be significant.

These are stress related diseases, and the causal organisms are opportunistic fungal pathogens which attack tissue weakened from other causes. Either fungus is capable of causing dieback, but frequently both are found together. Fruiting structures of coral spot Nectria canker are generally reddish orange to brown in color and often protrude from the lenticels of the bark. *Steganosporium* fruiting structures are black.

We recommend judicious pruning to maintain tree vigor and to remove disease-producing inoculum. It has been suggested that decline in urban maples may be retarded by careful selection of planting sites to avoid environmental stress.

Cristulariella Leaf Spot (caused by *Cristulariella* spp.) - This disease, which caused extensive leaf spotting and defoliation especially of boxelder in south central Maine in 1990, has since all but disappeared. Apparently the weather conditions which favor this disease, consecutive hot, summer days and nights with high dew points, have not recurred in Maine since that time.

Dogwood Anthracnose (caused by *Discula destructiva*) - Dogwood anthracnose, a serious disease of native flowering dogwood in the northeastern United States since the late 1970's, has now been found in Maine. We surveyed for this disease in late July in York County and, while we failed to find it in the only natural stand of flowering dogwood known to us in Maine (on Mt. Agamenticus in Kittery), the disease was found to be present and serious on ornamental flowering dogwood in York Village.

We do not yet know the extent to which dogwood anthracnose may be present on ornamentals elsewhere in York and perhaps Cumberland Counties, but surveys in Cumberland County in August failed to confirm the presence of this disease. Our native dogwoods other than *Cornus florida* appear to be resistant to this disease, so it seems unlikely that the causal organism will spread around the state on other species.

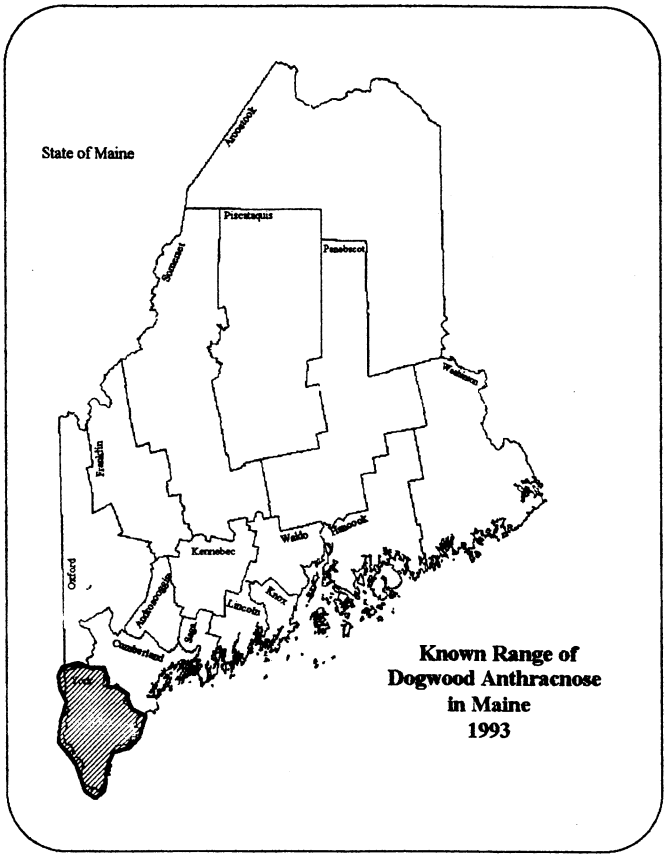

Figure 15

American flowering dogwood is a useful ornamental in Maine only in protected southern and south coastal locations. The lovely Chinese flowering dogwood (*Cornus kousa*) is somewhat hardier, and much less susceptible to dogwood anthracnose. We suggest it as an alternative, although it flowers a month or so later than *C. florida* and may have a bit of difficulty making it through its first Maine winter.

Dogwood anthracnose is characterized by small, purple-rimmed spots or larger tan blotches on leaves, and by watersprouts on trunks and larger branches. Control efforts are practical if trees are not heavily infected, and consist of pruning infected branches to reduce inoculum, repeated applications of fungicidal sprays, and conscientious cultural practices to enhance tree vigor.

Drought - The summer of 1993 was relatively dry and the effects were felt throughout the green industry. Although April was the ninth wettest since record-keeping began in 1895, with 167% of normal precipitation, June was near normal (except in northern Maine which experienced greater than normal precipitation). Then in July Maine received only 67% of normal precipitation and August was about as dry. Both months experienced above normal temperatures.

We received many calls of landscape trees casting apparently healthy leaves to reduce transpirational stress and the new growth of such late flushing trees as fraser fir was wilted for extended periods. Many newly planted ornamentals exhibited scorched leaves where they were poorly watered following outplanting.

Drought can have long term effects on trees and shrubs. Fine root hairs, which function in water and nutrient absorption, often collapse and die during periods of drought. Until they regenerate, trees become severely stressed and susceptible to all manner of negative outside influences, especially insect and disease organisms. Often trees decline in the years following severe drought, making our task as diagnosticians

difficult as we may attempt to relate the cause of tree decline to the organisms present on the tree at the time the call for diagnostic assistance is received, and fail to consider the long term effects of drought.

Dutch Elm Disease (caused by *Ophiostoma ulmi* and *Ophiostoma novo-ulmi*) - In recent years we have reported the appearance of an aggressive "subgroup" or "strain" of the fungus which causes Dutch elm disease. This more aggressive "strain" is now considered to be a separate species, *Ophiostoma novo-ulmi*. This "new" species may in fact already be more common in Maine than the original species (*Ophiostoma ulmi* syn. *Ceratocystis ulmi*) which caused the epidemic that swept through the state beginning about 1951. In fact, there is accumulating evidence that the original fungal species may be in danger of extinction as it is apparently being replaced in nature by this more aggressive species.

The implications of the appearance of this new species are grim indeed, since its greater virulence renders it capable of infecting elms which are at least moderately resistant to the "original" Dutch elm disease organism.

We don't yet know if the Dutch elm disease resistant cultivars of American elm now being planted in Maine are capable of surviving infection by this new, more aggressive species. But there is at least some evidence that many of these resistant cultivars were tested for resistance in the presence of the aggressive strain while they were being developed.

Eastern Dwarf Mistletoe (*Arceuthobium pusillum*) - Severe damage as the result of infection by this parasitic plant is still occurring in stands of white spruce in coastal areas of Maine. Trees of landscape value succumb each year in the yards of coastal residences as this organism gradually drains trees of their vigor. Removal of witches' brooms (infected portions of branches), together with appropriate fertilization, generally helps to maintain the vigor of affected landscape trees.

Dwarf mistletoe also frequently occurs on black spruce, particularly in bogs, and on red spruce in forest lands. Brooms on red spruce are often more poorly developed than on white or black spruce and may be overlooked. However infected residual trees left during timber harvesting activity can result in the infection of spruce regeneration. Infected trees should therefore be identified if possible and removed during the harvesting operation.

Entomosporium Leaf Spot (caused by *Entomosporium mespili* syn. *Fabraea maculata*) - We received no specimens of this disease in 1993.

Fir-Fern Rust (caused by *Uredinopsis* sp.), and Fir Fireweed Rust (caused by *Pucciniastrum epilobii*) - We received relatively few reports of fir-fern rust and fir-fireweed rust from Christmas tree growers last year, perhaps due to the success of growers in eradicating alternate host plants. But successful infection periods apparently did occur in 1993, as we picked up one rust or the other in 12 of 103 forest health monitoring plots.

We also received one report of fir-blueberry rust (caused by *Pucciniastrum goeppertianum*) although the homeowner was primarily concerned with damage to highbush blueberry, not fir.

Girdling Roots (caused by improper planting practices) - Planting mistakes of many years past still haunt homeowners throughout the state. For example we responded to a call last summer regarding one dying silver maple but actually found three silver maples, all in a row, with massive girdling roots. All had been planted at the same time, 27 years ago, as bare root stock which was apparently "twisted" into undersized planting holes by a local nurseryman (who is now out of business). The trees had grown reasonably well until recently, when the increasing diameter of the poorly positioned roots began to interfere with translocation of water and food at the tree root collar.

When planting landscape trees it is critically important to assure that roots are spread radially from the tree and that the planting holes are adequate in diameter to accommodate all roots in proper positions. In fact, a planting hole twice as wide as the root ball or root spread is advised to encourage rapid establishment of roots into prepared and loosened soil. We suggest you expend your energy digging a broad hole rather than a deep hole. A hole deeper than the root ball will not contribute to a tree's successful establishment, and may cause the tree to "subside", eventually resulting in its being set too deeply.

Heat Injury (caused by the sudden onset of hot weather in June) - New shoot growth of balsam fir and to a lesser extent white pine turned suddenly limp and off color during the week of June 13, 1993. Symptoms were most conspicuous on balsam fir, especially in northern sections of the state. Aroostook County, and northern portions of Washington, Penobscot and Piscataquis Counties, were especially hard hit, but the damage extended into south central Maine as well.

The effect on forest trees, though striking in appearence on scattered individual trees, was negligible. On Christmas trees the damage was of somewhat greater concern, but as the season progressed the dry brown tips tended to "weather" off and typically a large vegetative bud developed just below each brown tip, portending strong replacement shoot growth for 1994. Christmas tree salability for 1993 was largely unaffected.

We feel strongly that this was a weather related problem. A sustained period of cool weather in early June fostered tender, succulent shoot growth that was followed by high temperatures early in the week of June 13. Apparently the sudden onset of hot weather set into motion transpirational forces greater than certain trees could effectively tolerate.

Herbicide Damage (caused by misapplication of registered weed killers) - We continued to receive many complaints in 1993 of desirable landscape plants being damaged by registered herbicides. Many of these herbicides are designed to eliminate broadleaved weeds from lawns but are easily taken up by tree roots growing beneath the lawn surface. Lawn care products containing dicamba (Banvel) are especially risky in the root zone of desirable trees. But some of the newer lawn care herbicide formulations seem to be causing problems as well, especially to hemlock hedges where hemlock borders fine turf areas.

We suggest that if such herbicides must be used near the root zones of desirable plants, that application rates in those areas be cut in half.

Horse-chestnut Leaf Blotch (caused by *Guignardia aesculi*) - This disease seems to occur every year wherever horse-chestnut grows in Maine. In 1993, however, the expression of disease symptoms was milder than usual at most locations.

Hypoxylon Canker (caused by *Hypoxylon* spp.) - This is perhaps the most serious disease of aspen (poplar) in Maine and is present throughout the state. Cankers begin as sunken yellowish areas on the stem and enlarge rapidly. Bark frequently assumes a loose, blistered appearance at first then becomes gray-black and crusty as cankers age. Frequently trees break off at the point of cankers during ice, snow, or wind storms.

In 1993 this disease was reported from only 8 of 103 forest health plots, but is present in most poplar stands wherever they occur within the state.

Late Spring Frost - Christmas tree growers, particularly those with farms in perennial frost pockets, breathed a collective sigh of relief last spring as the season passed without a major spring frost episode. There was a bit of frost the morning of May 14 in south central portions of Maine, but damage to balsam fir was relatively light. We also had a report of minor frost damage to a balsam fir plantation in a frost pocket in the central Maine town of Levant.

Meadow Vole Damage (caused by *Microtus pensylvanicus*) - Over the winter of 1992-93 meadow voles decimated a four foot tall 42 acre European larch plantation in Oxford County. The plantation contained a heavy grass cover which, over the past few years, had provided an ideal situation for buildup of vole populations. Growers should remember that plantations set out without grass control are potential candidates for such serious damage and the use of herbicides, poison baits, and/or regular mowings should be considered if substantial vole damage seems likely.

Mechanical Damage - Misuse of string trimmers accounts for an increasing percentage of the tree problems we observe in residential, park, and industrial settings as well as in cemeteries and on golf courses. Often the damage to tree stems is relatively inconspicuous even when tree crowns have progressed well into advanced stages of decline.

Oak Wilt (caused by *Ceratocystis fagacearum*) - To date there is no evidence that this disease occurs in Maine.

Phomopsis Galls (caused by *Phomopsis* sp.) - Every year we receive a few calls regarding the presence of galls on various species of hardwoods, especially red and black oak. This year we had a call on maple as well. These galls are often very conspicuous, ranging from the size of a pea to the size of a basketball, and are especially evident when leaves are off the tree. Typically one or two trees will be affected in the landscape, with neighboring trees apparently not susceptible. Frequently galls will cause dieback of smaller branches, but generally trees seem to tolerate infection fairly well.

This is a difficult disease to diagnose with certainty because no fungal fruiting bodies are apparent on the galls. The fungus must be cultured from infected tissue and allowed to fruit before a positive diagnosis can be made.

Little is known about the etiology of this disease and it is therefore difficult to recommend effective control actions. However we suggest that in forest stands affected trees be harvested early or as encountered to reduce inoculum, and in landscape settings that affected trees be diagnosed early so that attempts may be made to prune infected tissue from trees before the disease gets out of hand.

Pine Needle Rust (caused by *Coleosporium asterum* syn. *Coleosporium solidaginis*) - We received two reports of this disease in 1993, both from plantations of jack pine. One came from Bradstreet Township and the other from nearby Sandwich Academy Grant in northwestern Maine. Normally, most reports we receive are from red pine plantations.

Like many (not all) rust fungi, *Coleosporium asterum* has an alternate host. In Maine the alternate host is frequently goldenrod, which is commonly abundant in old fields planted to red pine. Once plantation pine has developed sufficiently to close a canopy, the goldenrod becomes shaded out and the problem all but disappears.

As spectacular as the expression of this disease may be, it is generally of minor importance. In the most seriously affected plantations, growth of young pine may be temporarily retarded, but tree mortality is rare.

Pine-Pine Gall Rust (caused by *Endocronartrium harknessii*) - This disease occurs in natural stands as well as forest and Christmas tree plantations in Maine. We have found it in natural stands of jack pine in such diverse locales as Parlin Pond and Steuben, and in plantations of Scotch and jack pine from all over the state. It occurs especially frequently in Scotch pine plantations, even where no nearby infection is present in the wild, as the result of the planting of infected nursery stock. We received two inquiries about pine-pine gall rust in 1993, one from a jack pine plantation in Bradstreet Township and the other from a Scotch pine plantation in Mt. Vernon. In the Bradstreet Plantation, approximately ten percent of the trees showed galls. Affected trees were 6 to 10 feet tall and about 2-3" in caliper.

Once established in a plantation this disease may be hard to manage. Removal of infected trees (or branches containing galls) early in the rotation and before the end of April each year will help keep the disease from spreading to healthy trees. It is important when establishing plantations of hard pines to plant only healthy nursery stock.

Pinewood Nematode (*Bursaphelenchus xylophilus)* - The pinewood nematode, which causes the most serious disease of pines in Japan (pine wilt), also occurs in the United States, in all states east of the Mississippi River. However it has generally been regarded here as a non-economic pest, sometimes associated with dying pines and certain other conifers but is not generally considered to be a primary causal factor. It has been significant in North America primarily because its presence has resulted in embargoes which prohibit the shipment of raw softwood products to some portions of Europe and Asia.

We have conducted limited surveys for pinewood nematode in Maine since 1983 but have found it infesting only three coniferous species; balsam fir, white pine, and red pine. However it may be present in the wood of other coniferous hosts here as well.

Although pinewood nematode (PWN) was not discovered in the United States until 1929, it is considered to be a native, not introduced, pest. There is no indication that PWN has ever caused large scale mortality of conifers in Maine or elsewhere in North America. However a finding in 1993 has led us to suspect that pinewood nematode may be a more significant pest than we previously had thought. Trees near the center of a 30 year old red pine plantation in the central Maine town of Cambridge suddenly began to die about two years ago of no apparent cause. While not on the best of red pine sites, trees had grown well since they were planted until about four years ago, when growth suddenly began to slow. Trees then began to die in the center of the plantation and surrounding trees became symptomatic. Presently about 8 acres are affected.

Suspicious that pinewood nematode might be involved, we sampled three symptomatic trees and one healthy tree for the presence of *B. xylophilus*. Nematodes were abundant in the symptomatic trees but none were found in the healthy tree. The nematodes we isolated were confirmed to be *B. xylophilus* by Dr. Dale Bergdahl and Shari Halik of the University of Vermont.

The insect vectors which most commonly spread pinewood nematode (*Monochamus* spp.) are abundant on the site, and present the potential for further spread within the plantation.

We still believe that pinewood nematode in Maine is primarily a problem of stressed trees, especially those stressed by being planted off site. But many plantations (including ornamental plantings) are in fact established off site and we suspect that pinewood nematode has played a role in the mortality of pine and perhaps other species in such situations, even though the presence of pinewood nematode was never confirmed.

Plum Pocket (caused by *Taphrina communis*) - Beach and Canada plums in Maine sometimes produce swollen, bladder-like fruits as the result of infection by a fungus which is closely related to the peach leaf curl fungus. We rarely receive reports of this disease but did receive one sample from Belgrade early last spring on Canada plum. Pistils of affected flowers were distorted, exhibiting swollen ovaries and twisted styles.

While peach leaf curl affects young leaf and stem tissue, the plum pocket organism affects primarily flowers and fruit. Chlorothalonil is registered for control of peach leaf curl, and we expect it would be effective as well for control of plum pocket if sprayed early in the spring while trees are dormant. Mancozeb also has activity against *Taphrina* species, and may be an effective control option.

Porcupine Injury (caused by *Erethizon dorsatum*) - Last spring we revisited several landscapes, forest stands, and Christmas tree plantations where porcupines had caused heavy destruction during the previous winter (1991-92). We found that similar damage levels had occurred during the 1992-1993 winter season, in the same areas, and often on the same trees. Porcupine populations tend to run in cycles of 10 to 20 years and we seem to be at a high point in one of those cycles.

Much of the injury we observed last spring apparently occurred during November and December of 1992, but some also was fresh. We are not porcupine experts, so we don't know if this is typical, but the late fall and early winter damage we noted was not necessarily closely associated with dens while the fresh damage was almost entirely located proximal to den entrances and exits.

Where porcupines are a problem they may be easily dispatched with a shotgun assuming they can be found. They are quite conspicuous on warm spring days sunning themselves or feeding in deciduous trees before leaves emerge. But they will also feed heavily on conifers and are often inconspicuous hidden within evergreen foliage. When feeding on evergreens, however, they cut quantities of partially chewed twigs from trees. These accumulate beneath trees and often make it possible to locate porcupines you might otherwise miss. Toward evening, porcupines tend to move about on the ground, especially at dusk.

In 1993, porcupine damage was noted in 6 of 103 forest health monitoring plots.

Rhabdocline Needle Cast (caused by *Rhabdocline pseudotsugae*) - We received more specimens of Rhabdocline needle cast than usual last spring, particularly from ornamentals in coastal areas. In recent years inquiries about this disease have trended downward, probably the result of Christmas tree growers giving up the production of Douglas fir. For most growers, the repeated sprays of chlorothalonil and roguing of trees necessary to effectively grow Douglas fir is simply not worth the hassle.

This year we received specimens of Rhabdocline needle cast from Biddeford, Penobscot, and Mt. Vernon, Maine.

Root Rot of Balsam Fir (caused by an unidentified fungus) - The incidence of root rot in balsam fir Christmas tree plantations seemed to stabilize in 1993, particularly on old potato land in Aroostook County. This disease is frequently associated with wet areas in otherwise moderately well-drained fields. Typically, trees have been outplanted for several years before symptoms became apparent. Affected trees exhibit reduced growth and off color for a year or two, then turn red or brown as they finally succumb. At this point the root systems have deteriorated so far that trees can be easily plucked from the field by hand.

Certain growers have been coping with this problem by roguing trees as they become symptomatic, and not replanting affected areas. So far this seems to be a reasonably successful approach.

Salt Spray Damage - Salt spray damage to evergreen trees and shrubs was conspicuous over much of the state last spring. Most of the damage noted was the result of deicing salt which had been applied to highway surfaces and then atomized by passing traffic. Large tractor trailer rigs were especially effective at creating swirling wakes which scattered salt spray to nearby vegetation. The foliage of white pine and hemlock was severely browned due to the desiccant action of atomized road salt along major limited access highways and also along many other major roadways. The foliage of red and white spruce, and Scotch, red and mugo pine, also exhibited symptoms of leaf scorch, although generally to lesser degrees. Arborvitae foliage seemed to be relatively resistant.

Salt spray along coastal areas generated by hurricane force winds during the "Blizzard of '93" (March 13-14) also caused substantial injury to white pines and other conifers in coastal areas. Damage was particularly severe to white pine in the Saco/Old Orchard Beach area as well as the York/Ogunquit beach area near Perkins Cove. And on "down east" coastal peninsulas and islands, adjacent to the open ocean,

salt spray injury was very common on east facing shores on white and red spruce and balsam fir and, in the few areas down east where it grows close to the ocean, on white pine as well.

Scleroderris Canker (caused by *Ascocalyx abietina*) - No new infestations of this disease were reported during 1993.

Septoria Leaf Spot of Dogwood (caused by *Septoria* sp. prob. *S. cornicola*) - While we were surveying last summer to delineate the range of dogwood anthracnose, we encountered Septoria leaf spot, another foliar disease of dogwood, on a property in Windham. Symptoms were very similar to dogwood anthracnose (brown spots with purple borders) on leaves, but microscopic examination revealed fruiting bodies with asexual spores which were much larger than those of the dogwood anthracnose organism and one to three-septate.

We make note of this finding here as a caution to those in the green industry not to jump too quickly to conclusions when finding anthracnose-like spots on flowering dogwood. Please send suspicious samples to us and we will attempt to provide an accurate determination.

Sirococcus Shoot Blight (caused by *Sirococcus conigenus*) - This disease has been increasing in recent years, and continued to be considerably worse than usual in 1993 in the Cathedral Pines area in and around Eustis. Not only is it presently increasing in intensity in many natural stands, but we increasingly find it spreading into ornamental plantings and forest tree plantations which are close or adjacent to infected natural stands.

Sirococcus shoot blight has the potential to kill entire plantations of red pine trees once the disease becomes established and spreads within the plantation.

Recent Canadian research* suggests that Sirococcus shoot blight may be successfully controlled by (repeatedly) pruning out infected shoots and branches in young plantations late in the fall or before spore release in the spring. This is probably a practical recommendation if plantations are diagnosed early enough (before too many shoots become infected). However, by the time this disease becomes apparent to many land managers, it may no longer be cost effective to prune out affected shoots because of their large numbers.

In 1993 we recommended sanitation for control of this disease in a ten year old plantation of red pine near Eustis by pruning all affected shoots, together with the harvest of all nearby infected trees. Although pruning of flagged (infected) branches initially seemed to be a reasonable proposition, it turned out to be very labor intensive, and the sanitation effort was terminated.

An average of twenty two percent of 503 trees per acre were infected, with 2-5 infected tips per tree in the most heavily infected areas (adjacent to the infected natural stand). Trees were 10-15 feet tall and about 10 minutes per tree were required to prune affected tips and remove them from the plantation. Overall cost per acre for the initial sanitation effort in the worst areas was estimated to be about $100, although sanitation costs would have been somewhat less had the sanitation effort continued into the less heavily infected areas of the stand. However total control was not likely to have been achieved with just the initial sanitation effort, and follow up work would have been needed to be scheduled in ensuing years for complete control.

Land managers contemplating the establishment of red pine plantations near areas of infected natural red pine would probably be well advised to select a resistant alternate species (white or Austrian pine) or at least to remove nearby infected vegetation before planting, regularly monitor newly established plantations, and begin sanitation efforts immediately upon the onset of symptoms.

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* Magasi, L.P., and A.W. MacKay. 1993. Silvicultural control of Sirococcus shoot blight in young red pine plantations in Nova Scotia. Res. and Dev. Tech. Note No. 28. Nova Scotia.

Sphaeropsis Blight (caused by *Sphaeropsis sapinea* syn. *Diplodia pinea*) - This disease, primarily of two-and three-needle pines, seems to have increased in severity in recent years, especially on red pine in mid-coastal areas. Plantation pines seem especially hard hit with symptoms ranging from tip blight to the death of entire trees.

Other than in older red pine plantations in coastal areas, this disease is mostly a problem in landscape plantings around homes and estates, parks, along roadsides and on golf courses. It is generally not a problem in the natural forest environment.

Stillwell's Syndrome (associated with *Armillaria* spp.) - The occurrence of this disease seemed unchanged from 1992. No new concentrations of red fir were found in any of the affected portions of the state. Even though new symptomatic trees appear each season, rates of occurrence remain generally low. Damage in 1993 was at a very low intensity (<2 percent) and limited to scattered, individual fir trees.

White Ash Dieback (caused by heavy 1992 seed production plus likely cold weather stress) - Scattered individual white ash trees, particularly females which bore heavy seed crops in 1992, leafed out relatively late last spring and contained many dead shoots especially in mid to lower crowns. This phenomenon was not limited to Maine but was common throughout New Hampshire and Vermont as well.

This problem is distinct from ash yellows (which as far as we know does not occur in Maine) and brown ash decline, which has different symptoms and seems not to affect white ash.

As the 1993 season progressed, most affected ash improved somewhat in appearance, particularly at the tops of tree crowns, but a great many trees were still decidedly thin at the time of autumn coloration.

White Pine Blister Rust (caused by *Cronartium ribicola*) - We continue limited control efforts to manage this disease in certain high value pine stands each year, but due to funding constraints we no longer are able to cover the entire resource in a timely manner. In 1993 a total of 4,997 acres of high quality pine timber were scouted for Ribes plants in York and Cumberland Counties. A total of 4,445 Ribes were destroyed.

Each year we receive a few homeowner calls regarding blister rust infections in landscape trees, especially from older housing developments which were established in old fields which were then regenerating to white pine. Often regenerating pines were left to become landscape trees, even though many had been infected by the blister rust fungus. Now, as they begin to die, we get called in to try to "save" them, though it is often too late. While our control program to protect the white pine resource does not extend protection to landscape trees, we can and do recommend pruning or excision of cankers from infected landscape pines to eliminate disease infections once they have occurred, assuming we can catch them early enough.

Wind Damage - While we had some powerful windstorms during the year, most notably the "Blizzard of 93" in March, the passage of a cold front accompanied by brief high winds during June seems to have generated the most reports of wind damage. The damage, while minor, broke or distorted succulent new shoot growth on many evergreen trees and shrubs, especially where they were exposed to the northwest.

Christmas tree growers were particularly concerned, but as the season progressed most broken shoots weathered off by themselves and the few distorted shoots which remained did not greatly affect tree marketability.

Winter Browning (Winter Injury) - Foliage of red spruce in many parts of the state died and turned brown early last spring as the result of winter injury. While the symptoms were most intense at higher elevations in Oxford, Franklin, Somerset and Piscataquis Counties, we received many reports from Knox, Hancock and

Washington Counties as well. As conspicuous as this phenomenon was in Maine, it was worse to our west; symptoms were particularly striking in the mountains of northern Vermont and New York.

In the western mountain region of Maine our aerial survey estimated the following acres by county to be symptomatic (Figure 16):

Oxford:	658,560
Somerset:	1,254,400
Piscataquis:	689,920
Franklin:	752,640

Within the area, hardest hit stands were above 2,500 feet on rocky/ledgy sites. Although this portion of the State contained the most concentrated area affected, individual occurrences of winter browning were noted from the ground throughout the state.

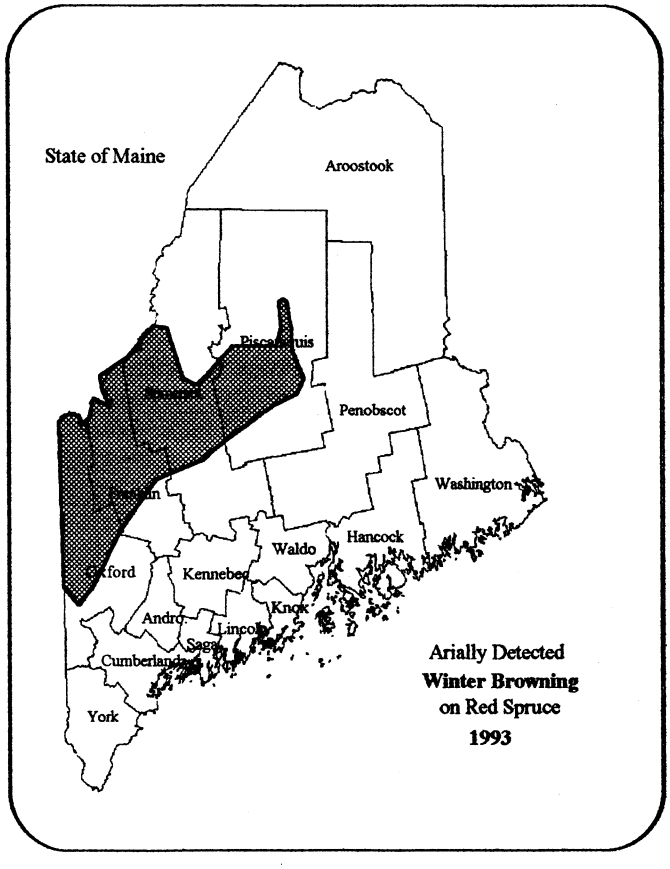

Figure 16

Compiled and Edited by Richard G. Dearborn and Clark A. Granger

Forestry Related Quarantines in Maine

There are four forestry related quarantines which are in effect in Maine. They are: White Pine Blister Rust, Gypsy Moth, European Larch Canker, and Hemlock Woolly Adelgid.

I. The White Pine Blister Rust Regulations and Quarantine are listed under Title 12 MRSA 1988, Subchapter III, §803:8305 Shipment Prohibited.

The director may prohibit, prevent or regulate the entry into or movement within the State, from any part thereof to any other part, of any plants of the genus *Ribes* or other nursery or wildling plants, stock or parts of plants which may cause the introduction or spread of a dangerous forest insect or disease. The director may issue the necessary orders, permits and notices necessary to carry out this section which shall not be considered to require or constitute an adjudicatory proceeding under the Maine Administrative Procedure Act, Title 5, Chapter 375.

Regulation: White Pine Blister Rust, Quarantine on Currants and Gooseberry Bushes.

A. The sale, transportation, further planting or possession of plants of the genus *Ribes* (commonly) known as currant and gooseberry plants, including cultivated wild, or ornamental sorts) is prohibited in the following Counties in the State of Maine, to wit: York, Cumberland, Androscoggin, Kennebec, Sagadahoc, Lincoln, Knox, Waldo, Hancock, and parts of Oxford, Franklin, Somerset, Piscataquis, Penobscot, Aroostook, and Washington.

B. The planting or possession of European Black Currant, *Ribes nigrum* or its varieties or hybrids anywhere within the boundaries of the State of Maine is prohibited. This quarantine is administered by the Insect & Disease Management Division of the Maine Forest Service, phone 287-2431 or 287-2791.

II. The Gypsy Moth Quarantine is listed under 7 CFR Part 301.45, United States Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection and Quarantine as printed in the Federal Register.

A. This quarantine designates the infested area in Maine as quarantined for the movement of regulated articles, which includes wood such as logs, pulpwood, trees, shrubs, firewood, Christmas trees, and chips, and requires the inspection and certification of such material if movement is to non-infested states and foreign countries. This is administered by the USDA-APHIS, PPQ in Bangor, Maine, phone 945-0479.

B. Inasmuch as Maine is not completely infested and quarantined, wood or regulated articles moving from the infested area of the state to the non-infested area must be accompanied by a certificate or go to a mill under state compliance agreement which allows the reception of such articles. Regulated articles moving from the non-infested area of the state to other non-infested states or non-infested parts of Canada must be accompanied by a state permit stating that the regulated article originated outside of the infested area of the state. This is managed by the Insect & Disease Management Division of the Maine Forest Service, phone 287-2431 or 287-2791.

III. The European Larch Canker Quarantine is listed under 7 CFR Part 301.91 of the United States Department of Agriculture, Animal & Plant Health Inspection Service, as published in the Federal Register, and also under Title 12 MRSA, §8305 of the Laws of the State of Maine.

A. This quarantines all parts of larch (*Larix* spp.) including logs, pulpwood, branches, twigs, etc., as regulated articles.

B. Also any other product, article, or means of conveyance whatsoever, when it has been determined by an inspector that it presents a risk of spread of the disease.

C. Designates parts of Hancock, Knox, Lincoln, Waldo, and Washington Counties as the quarantined area from which movement is restricted.

This is managed by the USDA-APHIS, PPQ in Bangor, Maine, phone 945-0479, and the Insect and Disease Management Division of the Maine Forest Service, phone 287-2431 or 287-2791.

IV. The Hemlock Woolly Adelgid Quarantine is listed under 7 MRSA, Chapter 409, §2301-2303 of the Laws of the State of Maine.

This quarantine was adopted to attempt to prevent the introduction of the Hemlock Woolly Adelgid (*Adelges tsugae* Annand) into Maine. This pest has been found to cause mortality of Eastern Hemlock (*Tsuga canadensis*) in infested states. Since hemlock is a major component of Maine's forest on over one million acres, protection of this valuable resource from damage by the Hemlock Woolly Adelgid is essential.

A quarantine is established against the following pest and possible carriers.

A. Pest: Hemlock Woolly Adelgid (*Adelges tsugae* Annand).

B. Area Under Quarantine: The States of Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, Alaska, California, Oregon, Washington, and the District of Columbia.

C. Articles and Commodities Covered: Hemlock seedlings and nursery stock, logs, lumber with bark, and chips.

D. Restrictions: All articles and commodities covered are prohibited entry into the state from the area under quarantine unless specified conditions (listed below) are met.

1. Hemlock seedlings and nursery stock are: admissible into Maine provided each lot is accompanied by a certificate issued by the Department of Agriculture or Conservation of the State of the origin with an additional declaration that said material is free from Hemlock Woolly Adelgid.

2. Hemlock logs, lumber with bark, and chips are: admissible provided that said material is only shipped to preapproved sites within Maine. Such shipments must be made under a compliance agreement between the shipper and the Maine Forest Service, Department of Conservation. If said material is shipped to other sites, it must be accompanied by a certificate issued by the Department of Agriculture or Conservation of the state of origin affirming (a) the material was grown in the state of origin, and that either (b) the material is free from Hemlock Woolly Adelgid, or that (c) the material originated from an uninfested area in the state of origin.

This quarantine is administered by the Maine Department of Agriculture, phone 287-3891 and the Insect and Disease Management Division of the Maine Forest Service, phone 287-2431 or 287-2791.

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 8 - Mar. 1994

GYPSY MOTH IN MAINE IN 1993

Prepared by Dick Bradbury

Gypsy moth (*Lymantria dispar)* populations continued to decline in Maine in 1993. Aerial surveys delineated 50,694 acres of forested type which received some degree of defoliation (Figure 1). All of the defoliation was in York County with 44,330 acres exhibiting moderate to heavy defoliation and 6,364 acres light defoliation). This is the second consecutive year of decline from the high 1991 levels (Table 1).

Table 1. Total acres defoliated by Gypsy Moth in Maine during the current outbreak (1988-1993).

Year	Acres Defoliated
1988	100
1989	34,280
1990	270,432
1991	620,933
1992	278,485
1993	50,694

Mortality was highly variable after the winter of 1992-93 with a range of 0 to 100% hatch of eggs collected in March and April of 1993. Egg hatch from egg masses collected from below the snow line was poor at many sites although these traditionally hatch very successfully. The egg masses were presumed to be of poor vigor because they were very small and contained few eggs. Egg parasitism by *Anastatus disparis* and *Ooencyrtus kuvanae* was commonly observed at egg mass collection sites.

The first egg hatch was reported on May 3 in South Berwick and hatching was complete by May 17th. The peak of the second instar occurred around June 1. Development sampling was done biweekly until June 28th when the mean larval index was 5.12. Pupation was first noted on June 28th in several locations in York County.

Larval mortality was very high within many of the heavily infested forest stands resulting in the complete collapse of the gypsy moth populations in many of these areas. The principle pathogen in these epizootics appeared to be the nucleopolyhedrosis virus commonly referred to as "wilt disease". The larval fungal disease caused by *Entomophaga maimaiga* was also observed in many locations, however, but did not appear to cause any widespread plunges in the population levels. These observations were identical to those noted last year in areas heavily defoliated in 1992, but not damaged in 1993.

Limited sampling for gypsy moth parasites was conducted at three York County sites that were among the remaining areas in 1993 to suffer moderate to heavy defoliation. The sampling consisted of 50 late instar gypsy moth larvae collected on June 29th in Sanford and 50 pupae at all of the tree sites on July 10th. Due to time constraints gypsy moth larval samples were not taken in Saco and Wells. All of the gypsy moth larvae and pupae were placed in individual creamers and held at the laboratory until parasites emerged. The collected larvae were reared on oak foliage. At the end of eight weeks all dead pupae were dissected and checked for parasites. Parasitism and mortality results were recorded and are summarized in Table 2.

Table 2. Percent parasitism and mortality, late larval and pupal gypsy moth survey, 1993.

Location	Sample Size	Total % Parasitism	Total % Dead and Diseased
Saco	49 Pupae	4.1	91.8
Sanford	50 Larvae	18.0	82.0
Sanford	50 Pupae	18.0	46.0
Wells	50 Pupae	8.0	48.0

Accurate assessment of gypsy moth parasite composition and levels was impractical due to the high sample mortality and reduced sample size. The extremely high larval and pupal mortality in samples taken in Saco and Sanford appeared to be caused by nucleopolyhedrosis virus (NPV) which was observed to be especially

abundant at these collection sites. Parasitism was primarily by *Parasetigina sylvestris* and *Blepharipa pratensis*, two Tachinids that have been commonly recovered in previous years.

Pheromone trapping in townships lying along the quarantine line was again done in 1993 utilizing 234 'milk-carton' traps baited with 'plus' Disparlure. Trap catches were very low throughout the area trapped with all traps exhibiting a reduction in moths caught in comparison to the previous year. These results reflect the decline of the gypsy moth throughout Maine and give no reason to alter the location of the quarantine line within the state.

Egg mass population levels were sampled at 20 sites using fixed (one/two hundredth acre) and variable (10 BAF prism) plots at each site. Two of these sites harbored significant numbers of overwintering egg masses (over 500 em/acre) while the remaining 18 sites had a few if any new egg masses. Both sites were located in extreme southwestern Maine.

In summary, the gypsy moth populations and corresponding acreage damaged continue to fall in Maine. Current populations do not appear to be healthy in the few remaining sites where they are present and damage from this pest is expected to be very localized in York County in 1994 in Maine.

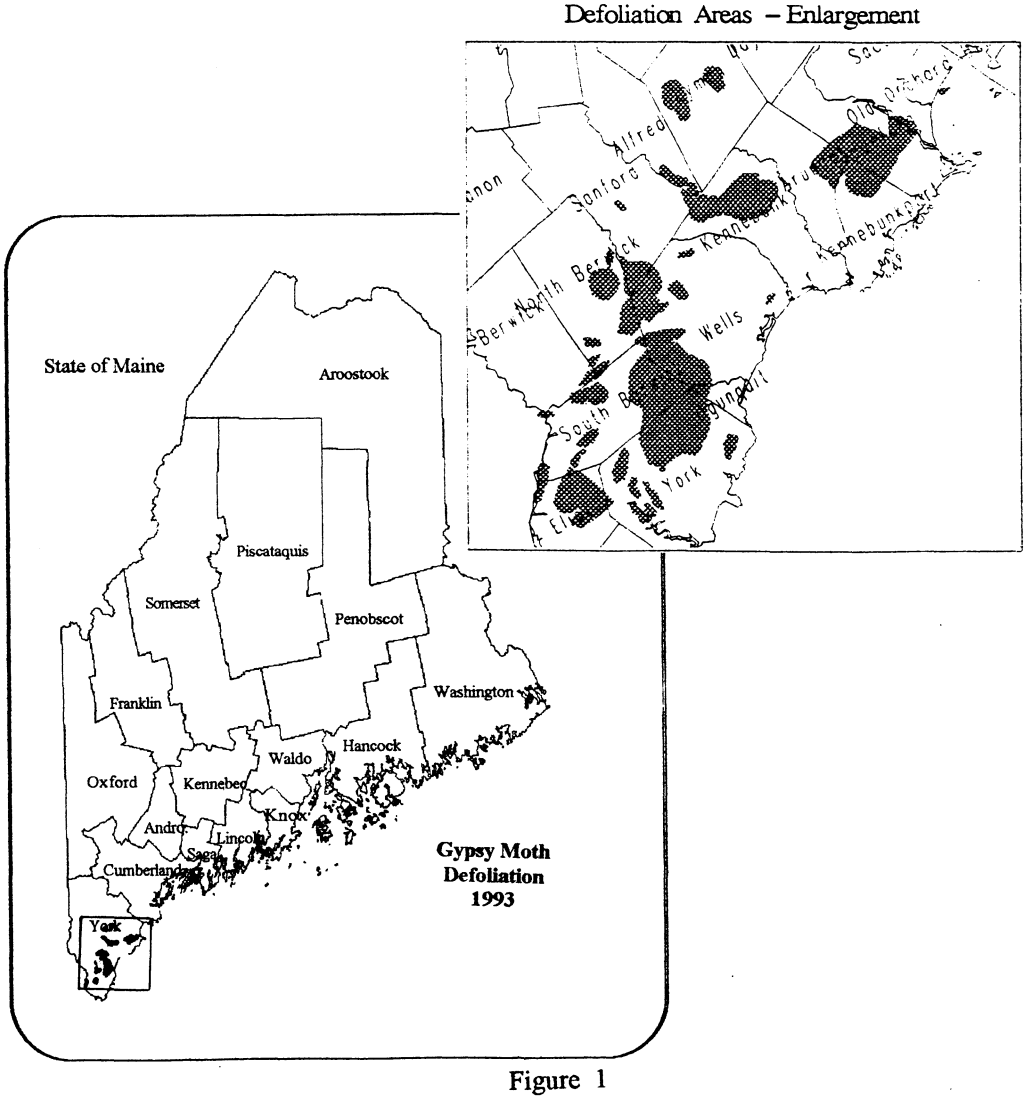

Figure 1

From: Maine Dept. of Conservation, Maine Forest Service
I&DM Summary Report No. 8 - Mar. 1994

THE HEMLOCK LOOPER IN MAINE - 1993

and a

FORECAST FOR 1994

Prepared by
Henry Trial Jr.

INTRODUCTION

The infestation of eastern hemlock looper (*Lambdina fiscellaria*) that began in Maine in 1989, continued to show evidence of a general population collapse that had begun in 1992. Observations during the summer of 1993 revealed that larval numbers were much lower than had been predicted by the 1992 egg survey in most areas, and even areas that had significant larval populations early in the feeding season showed unusually sharp reductions in population density by pupation time. Low larval numbers and weather conditions unfavorable to larval survival resulted in much less defoliation than in previous years. None of the 42,100 acres of defoliation mapped in 1993 exceeded the moderate category. The areas of moderate and heavy to severe defoliation had exceeded 218,000 acres in 1992.

Although the lessening infestation intensity reduced the time commitment needed by the Maine Forest Service (MFS), Insect and Disease Management (I&DM) staff, the current looper problem was still a major activity for the Division. Activities for 1993 included technical assistance to private and industrial landowners, surveys of larval population density and development, aerial and ground defoliation and damage surveys, assessment of moth activity with light and pheromone traps, and a fall egg density survey to predict 1994 population levels. In addition to these ongoing survey and assessment activities the MFS also cooperated with U.S. Forest Service, Forest Health Protection and several other New England states on two studies of hemlock looper impact on infested forests. The first of these studies was designed to determine the wide scale impact of *L. fiscellaria* and *L. athasaria* (a related species more common to the south and west of Maine) defoliation on hemlock and spruce-fir forest stands in Maine, New Hampshire, Vermont and Massachusetts. The second study was designed to examine the impact to hemlock in areas within Maine determined to be the most severely damaged during the current outbreak.

Insect Development

An attempt was made to track larval development throughout the 1993 season at two representative sites, Springfield and Franklin, and through intermittent sampling. Although initial populations at egg hatch were thought to be high enough for the periodic sampling normally used for this survey, larvae disappeared from both sites early in the development cycle. At the Springfield point, larval numbers dropped from approximately 15 per branch at egg hatch to less than 1 larvae per branch by the third instar. Larval numbers in the Franklin area were much lower initially than predicted by the 1992 egg survey and as in Springfield, the larval numbers decreased in the early instars to levels too low to sample effectively. Intermittent development sampling was done in east central Washington County where populations persisted in 1993 but this sampling was not adequate to produce development curves as in 1991 and 1992. The intermittent sampling showed that egg hatch in 1993 occurred at about the same time as in 1992, 1990 and 1989 and was about a week to 10 days later than it had been in the 1991 season. The first larvae noted were seen on June 1 in Lincoln and Springfield. The size and appearance of the larvae indicated that they had hatched within a day or two of the observation. Egg hatch in Franklin and other coastal areas was 10 days to two weeks later than in inland areas. Egg hatch in coastal areas in 1993 occurred at about the same time as in 1992 but larvae were very difficult to find due to low population density.

Weather conditions during May and early June were wet and cool. These conditions tended to retard development and did not favor larval survival. Later in the season conditions became more favorable for the looper. From mid June through pupation, temperatures were normal and there was very little rain. By pupation and moth emergence development had caught up to that seen in 1992, 1990, and 1989.

In 1993 moths did not appear until the second week of September. While in 1991, the only "early" season during this outbreak, moths began to emerge in late August. During this current five year outbreak, four years have been "late" and only 1991 was "early". It is interesting to note that 1991, where the weather was warm and dry and hatch occured 7 - 10 day earlier in the season, was by far the most extreme year of the outbreak in terms of defoliation.

Larval Observations

Population predictions generated from overwintering egg densities were checked in the spring of 1993 using a branch "beating" survey for larvae. The survey did not extend over the entire area that had been evaluated with egg sampling but many of the areas predicted to have moderate to severe larval density were checked. The survey results showed that many areas throughout the infestation had fewer larvae during the second instar than had been predicted by the egg survey. In some of the areas where larval numbers were expected to exceed 30 per branch based on egg density, very few larvae were present. Other areas with a similar predicted level had significant but reduced larval numbers (10 to 20 per branch); re-evaluation of many of these areas during later instars showed that very few of these larvae survived to the later instars. Low survival rates with hemlock looper are common but the rates in 1993 were extremely low even for looper.

Defoliation

An aerial and ground survey of 1993 hemlock looper defoliation was completed in late September and a total of 42,100 acres of the moderate (30 to 50 %) defoliation was mapped (Figure 1). Most of the 1993 moderate defoliation occurred in east central Penobscot, northern Hancock, and central Washington Counties on 68,000 acres which had sustained heavy to severe defoliation in 1992. No new areas of defoliation were seen. The heaviest damage recorded in 1993 was found in the north central portion of Washington county. Trees in this area are still in poor condition compared to trees in other portions of the mapped area. Except for this area, tree condition improved in 1993. Decreased severity of the 1993 defoliation was due to lower larval densities, poor larval survival, and cool and wet weather conditions early in the season that were favorable to tree bud development.

Almost all the defoliation recorded in 1993 occurred on old foliage and damage on new needles rarely exceeded 5 to 10 percent. Defoliation to one year old needles in the mapped area generally ranged from 50 to 90 percent and this combined with the defoliation to current needles resulted in total defoliation (defoliation of new needles + defoliation of one year old ÷ 2) in the 30 to 50 percent moderate category.

The lack of defoliation on 1993 needles made aerial defoliation mapping very difficult and ground verification was necessary to confirm that defoliation had occurred in 1993. Ground verification included checking for signs of 1993 insect activity such as webbing, feeding starts on 1993 needles, and insects (larvae, pupae, or moths). Defoliation recorded on one year old needles in 1993 was compared to records of defoliation on new needles in 1992 in the same locations to further verify that defoliation occurred in 1993 and not 1992.

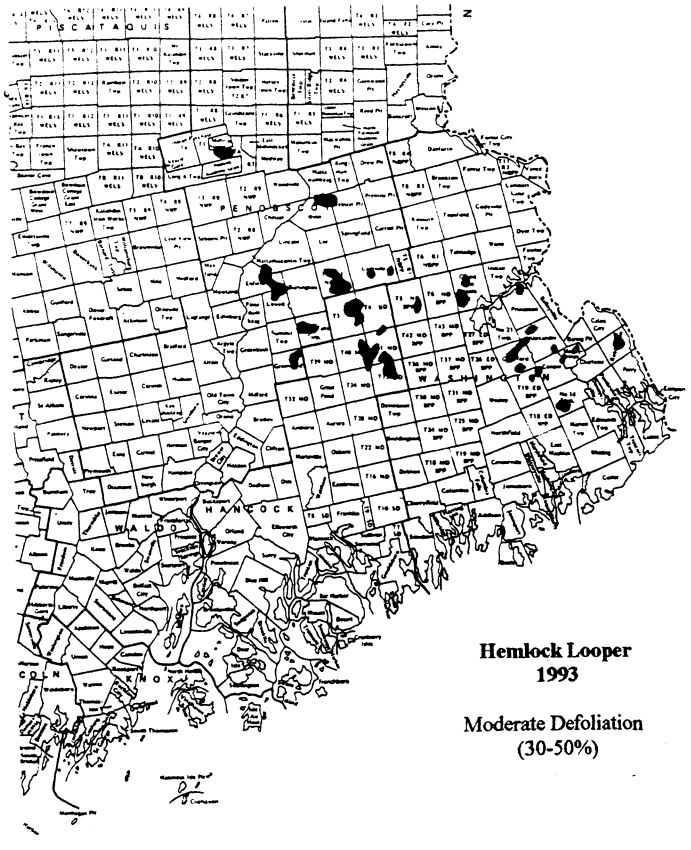

Figure 1

Light Trap Survey

The MFS continued to use it's light trap network to assess hemlock looper moth activity in 1993. As in 1992, the operating period of 11 of 23 traps (Figure 2) in the network was extended to include the looper moth flight period. In 1993 the extended operation ran from August 17 through the end of September. Light traps had been operated at nine locations to evaluate looper moth activity in 1991. Results for all three seasons are summarized in Table 1.

Looper moths were caught in 10 of the 11 light traps operated for looper in 1993 but the catch at all locations was down sharply compared to the 1991 and 1992 catch. The general trend in looper moth catch in light traps has been steadily downward since the peak catch in 1991. Two locations, Mt. Vernon and North Bridgton, had slightly higher catches in 1992 than in 1991 but the increases were not significant. The downward trend in light trap catch corresponds with similar declines in other measures of infestation intensity and supports the view that the current looper outbreak is nearing its end. In addition to this survey for *L. fiscellaria*, four of the light traps were operated early in the season for moths of the spring looper, *L. athasaria* (Figure 2).

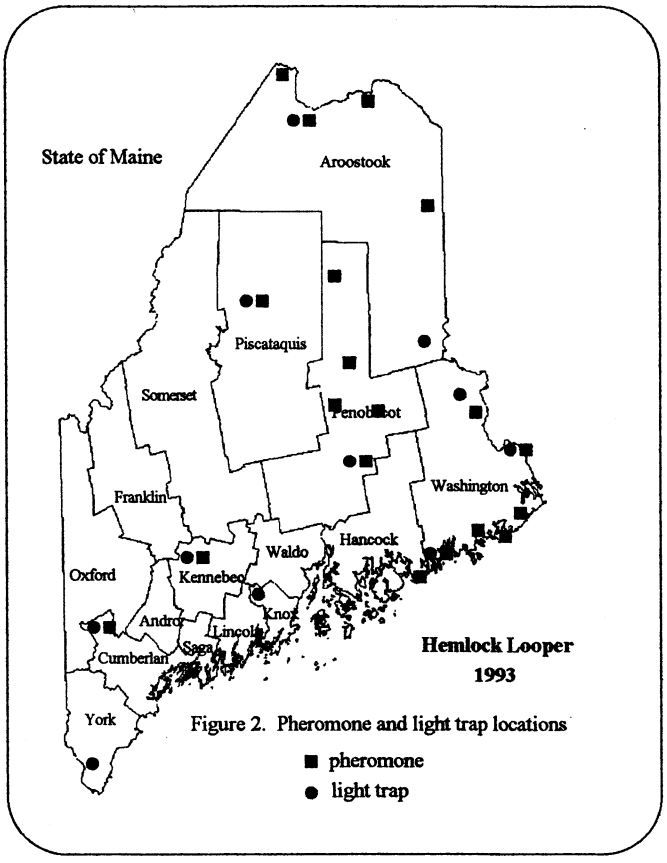

Figure 2. Pheromone and light trap locations

Table 1: Hemlock Looper Light Trap Moth Catch - Maine 1991 - 1993

Location	1991			1992			1993		
	# Male	# Fem	Total	#Male	# Fem	Total	# Male	# Fem	Total
Allagash				5	4	9	1	1	2
Calais	318	5,084	5,402	78	1,338	1,416	11	32	43
Chesuncook	30	16	46	11	5	16	9	4	13
Greenbush	9	42	51	2	4	6	0	1	1
Haynesville	9	18	27	3	2	5	0	0	0
Mt. Vernon	13	19	32	9	25	34	1	4	5
N. Bridgton	76	17	93	93	15	108	52	15	67
S. Berwick				244	159	403	156	130	286
Steuben	12	375	387	8	21	29	2	2	4
Topsfield	31	111	142	35	50	85	5	8	13
Washington	59	32	91	63	10	73	22	13	35

Moth Trapping With Pheromones

In addition to light traps, the MFS used pheromone baited traps in 1993 to assess looper moth activity. A similar survey was conducted in 1992. Sixteen locations were trapped in 1993 compared to 17 in 1992 with fourteen of the sites the same for both years. The locations used covered a wide range of looper population density from very low to high. Three looper pheromone baited traps were placed in a triangular pattern at each location (Figure 2). Moth catch was reported as the mean number of moths captured per trap (Table 2).

The mean moth catch per trap in areas assessed in 1993 ranged from a high of 109 at Waite in central Washington County to zero at Frenchville in northern Aroostook County. Some moths were caught at all locations except Frenchville but all locations except Mars Hill showed sharply reduced catch compared to 1992. At Mars Hill, twice as many moths were caught in 1993 as in 1992 but, the catch was still low. Based on comparisons with 1992 pheromone trap and egg density data, only the Waite catch could be considered moderate to heavy. As with light trap data, the 1993 pheromone catch indicates a sharp reduction in the looper infestation level.

Table 2. Hemlock Looper Pheromone Trap Moth Catch - Maine - 1992, 1993

Location	Moths Per Trap		Location	Moths Per Trap	
	1992	1993		1992	1993
Allagash	**	6	Mars Hill	8	15
Bucks Harbor	226	49	Millinocket	236	7
Calais*	263	23	Mt. Vernon*	20	***
Chesuncook*	58	***	N. Bridgton*	37	***
Estcourt	15	5	Seboeis Plt.	5?	16
Frenchville	2	0	Steuben*	195	25
Gouldsboro	54	29	T6 R8	61	23
Greenbush*	173	59	Waite	**	109
Jonesboro	74	27	Whiting	239	35
Lincoln	53	12			

*near MFS light trap location, **not used in 1992, *** not used in 1993

1993 Predictive Egg Survey

The MFS conducted a survey of hemlock looper egg density in 1993 to forecast 1994 populations. The survey encompassed the area that had significant defoliation in 1993 and much of the area where defoliation was mapped in 1992. Initial sampling density was relatively low in areas lightly defoliated in 1993 and somewhat higher in the moderately defoliated area. Survey methods were identical to that of previous years. After samples from the initial survey were processed, more sampling was done in those areas where moderate to severe egg densities were recorded. Maximum sample density in 1993 in the higher egg density areas was about three sample locations per township. The 1993 egg survey began in November and was completed by the end of December.

The 1993 egg survey showed a large area of heavy to severe egg density in east central Penobscot and north central Washington Counties (Figure 3). Higher egg densities were relatively uniform within a 15 mile wide west to east band starting at Carroll Plt. on the west to Baring Plt. in the east. In general, this heavy to severe area was close to the areas of moderate defoliation mapped during the 1993 damage survey and near the one area (Waite) where a high number of moths were caught in pheromone traps. If conditions are favorable, this area could experience heavy defoliation in 1994 but other factors may intervene.

The egg survey also disclosed smaller areas of moderate population density in southern York County, northern Lincoln County, and in southern Piscataquis County near Sebec Lake. The area near Sebec Lake is apparently a newly infested area. The other two areas had moderate to heavy egg densities in 1992 which resulted in light defoliation in 1993.

The egg density to defoliation relationship used to predict defoliation* in recent years proved to be an adequate predictor early in the current looper outbreak but was less accurate in 1992 as the infestation started to decline. In 1992, predicted larval numbers did not materialize in some areas. In other areas larval numbers were at the levels predicted in the early instars but declined rapidly in later instars. Both these situations resulted in less

* Trial, H. and J. G. Trial. 1992. A method to predict defoliation of eastern hemlock [*Tsuga canadensis* (L.) Carr.] by eastern hemlock looper [*Lambdina fiscellaria* (Gn.)] using egg sampling. Me. DOC, MFS, I&DM Div. Tech. Rpt. No. 31. 12 pp.

defoliation than predicted by the relationship. One possible explanation for inaccurate predictions in 1992 is that population quality was poor due to disease, parasitism, or other factors related to an infestation collapse. Another reasonable explanation is that weather unfavorable to larval survival has a substantial impact on the ultimate level of looper defoliation. During this outbreak, defoliation by looper was extremely severe in 1989 and 1991 when weather conditions were favorable whereas similar egg densities resulted in much less defoliation in 1990, and 1992 when weather was unfavorable. When interpreting 1993 egg density data, the impact of the declining nature of the outbreak and unpredictable influence of the 1994 weather must be considered. The cold, wet, and very late start to the 1993 larval development period undoubtably removed many young larvae from the population before they could cause any defoliation. This early loss of larvae probably reduced defoliation in many areas 20 to 50 percent below predicted levels and may have had a similar impact on 1993 egg densities.

Impact Studies

Two studies of the impact of hemlock looper on eastern hemlock and spruce-fir forests continued during 1993. The more general of the two studies was started after the 1990 season on hemlock stands in Maine and was expanded to include fir stands in Maine and hemlock stands in other New England states in 1991. Stands in other states had been defoliated by *L. athasaria* whereas all stands in the Maine study area had been damaged by *L. fiscellaria.* All plots were remeasured after the 1992 season. Currently, data from this study are being analyzed and a final report will be prepared by March 31, 1994. Results of this study are likely to show that looper damage was severe in small areas but that generally this pest did not cause widespread destruction like the spruce budworm.

Data for the second study were collected after the 1992 feeding season from areas identified as the most heavily damaged during the outbreak. Aerial surveys showed that more than 65,000 acres of forest experienced the severe level of damage evaluated by this study. Preliminary evaluation of these data shows that damage varies from complete mortality of hemlock to top mortality and growth loss. Most severely damage areas were either adjacent to water or on rocky or poorly drained sites. Severe damage also occurred in partially cut areas and in areas that had very high looper populations for several years. Even though severe looper damage is found on specific types of sites and stress situations, the impact in these areas is highly significant in terms of wood loss and reduced property value. A final report on this study will also be completed in March 1994.

Hemlock Looper Management

There are no previous reports of an outbreak like the one that began in Maine in 1989 even though hemlock looper is a native pest and has been a common component of MFS general survey collections for many years. Consequently very little was known about the need or strategies for managing looper in hemlock stands. In 1989,methods to assess looper damage and to evaluate and predict population levels for the next season did not exist. It was known that two looper species, *L. athasaria* and *L. fiscellaria*, were involved in defoliating stands locally, but their relative importance was not known. The ultimate damage potential of looper was also unknown, even though severe defoliation early in the outbreak suggested that significant losses were likely.

Hemlock looper has been in an outbreak phase in Maine forests for the past five years. The potential for looper to damage and perhaps kill trees had implications for large industrial landowners as well as owners of private homes and small woodlots. To address the damage potential of the looper outbreak and the concerns voiced by clients, the MFS began developing the tools necessary to manage this pest. As the outbreak declines, some management concerns remain but, many questions have been answered.

- Based on available literature egg density was chosen as a population prediction index. Survey methods for Maine outbreak conditions were developed and tested that resulted in a reliable prediction method that relates egg density to larval numbers and defoliation. Also, methods were developed to estimate larval density and to relate those densities to subsequent defoliation. Methods were also developed to utilize light and pheromone traps to evaluate moth activity and therefore assist in determining which areas need egg survey efforts.

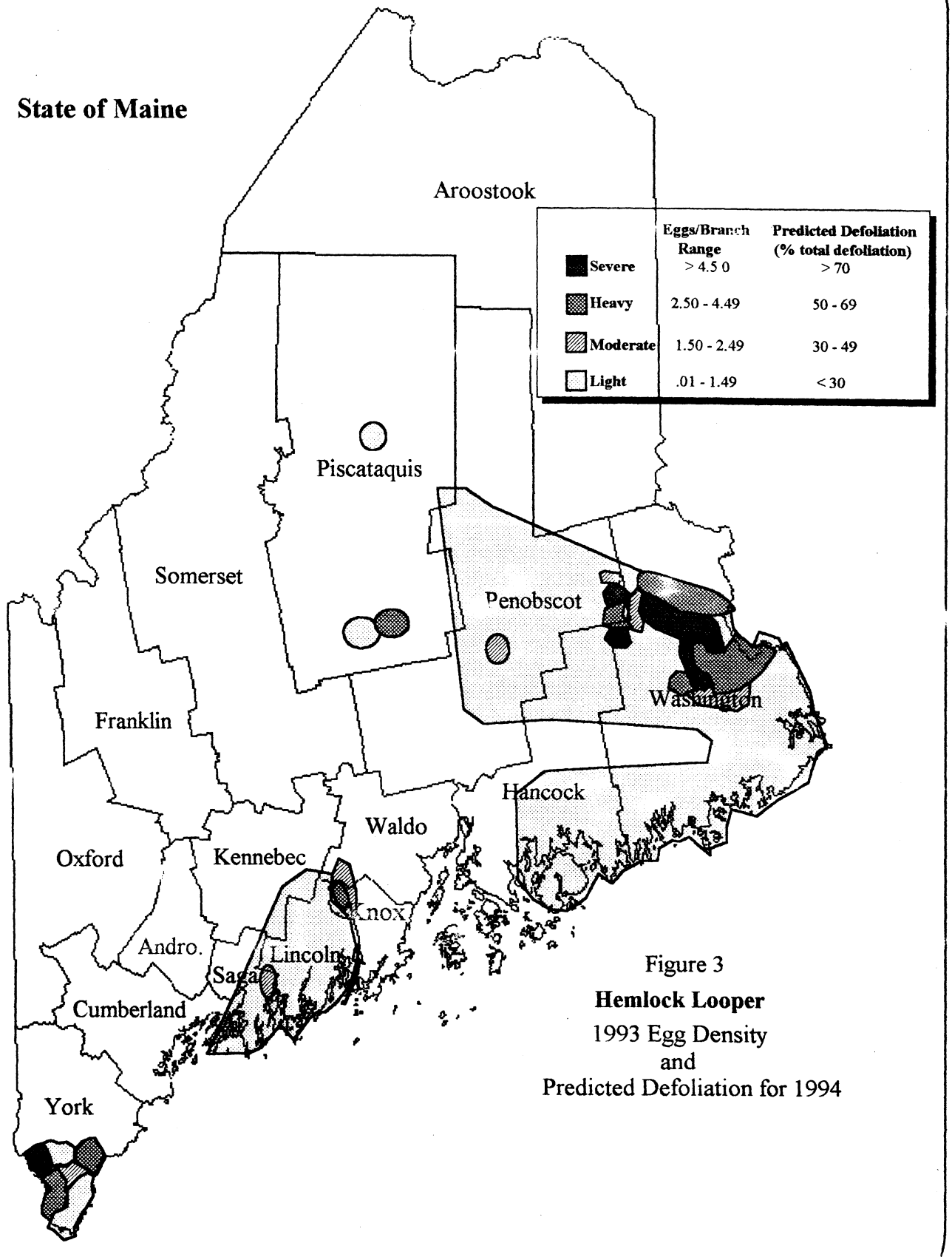

Figure 3
Hemlock Looper
1993 Egg Density
and
Predicted Defoliation for 1994

- Defoliation detection and evaluation methods were developed for hemlock, fir, and white spruce.
- The pest species composition of infested areas was determined and the predominant pest was *L. fiscellaria.*
- Impact studies were initiated to determine what combinations of infestation intensity, stand stress, and host species composition resulted in significant losses.
- Annual survey results, evaluations, and recommendations were transmitted to concerned landowners through: a periodic newsletter, meetings with industrial landowners, notices of high hazard areas sent to town officials, and annual conditions reports. Based on MFS recommendations, pest control with biological insecticides was confined to small high value properties, harvesting operations were relocated from low hazard areas to areas at high risk, and stands in need of salvage were identified.

Acknowledgments

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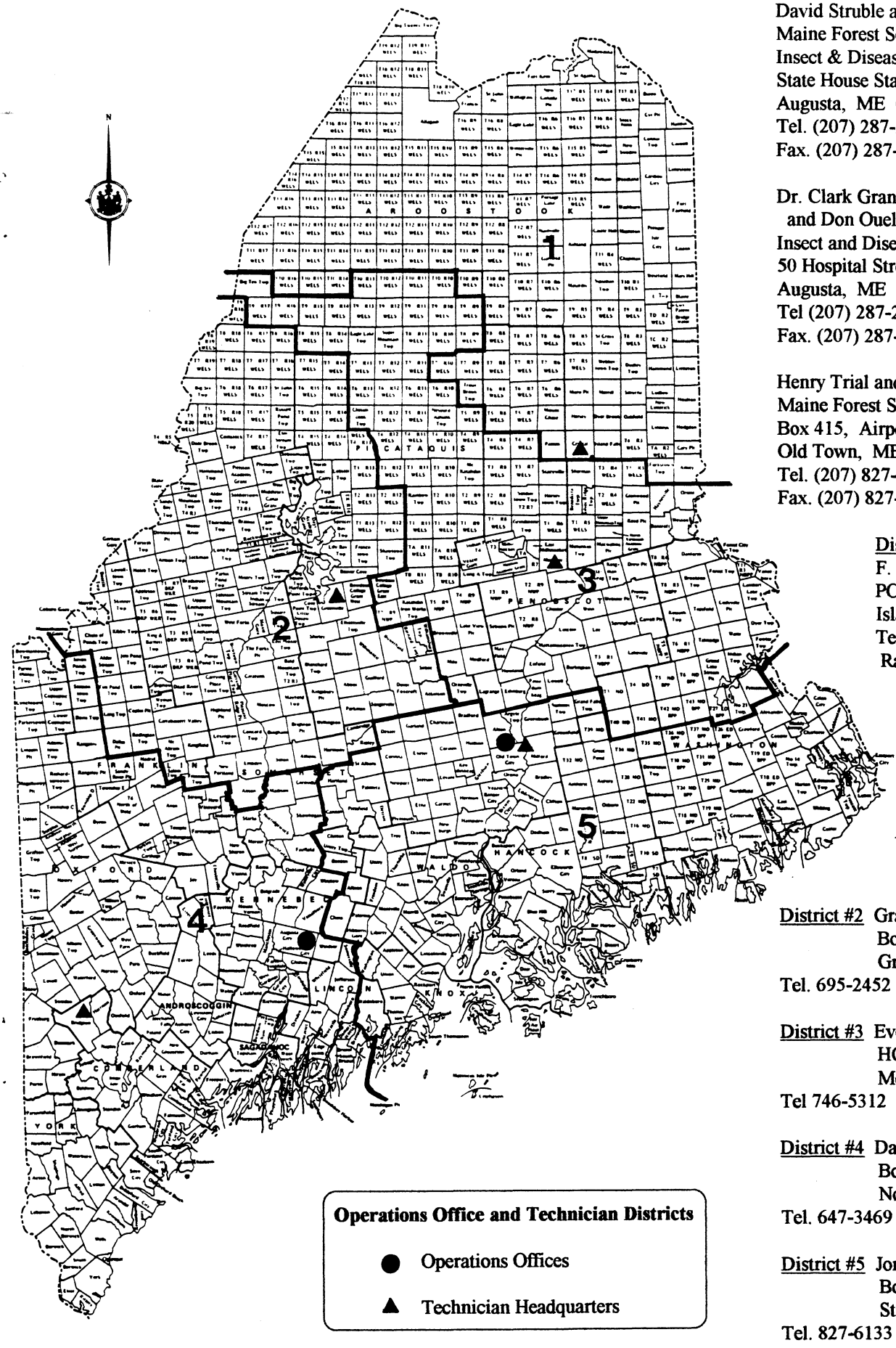

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